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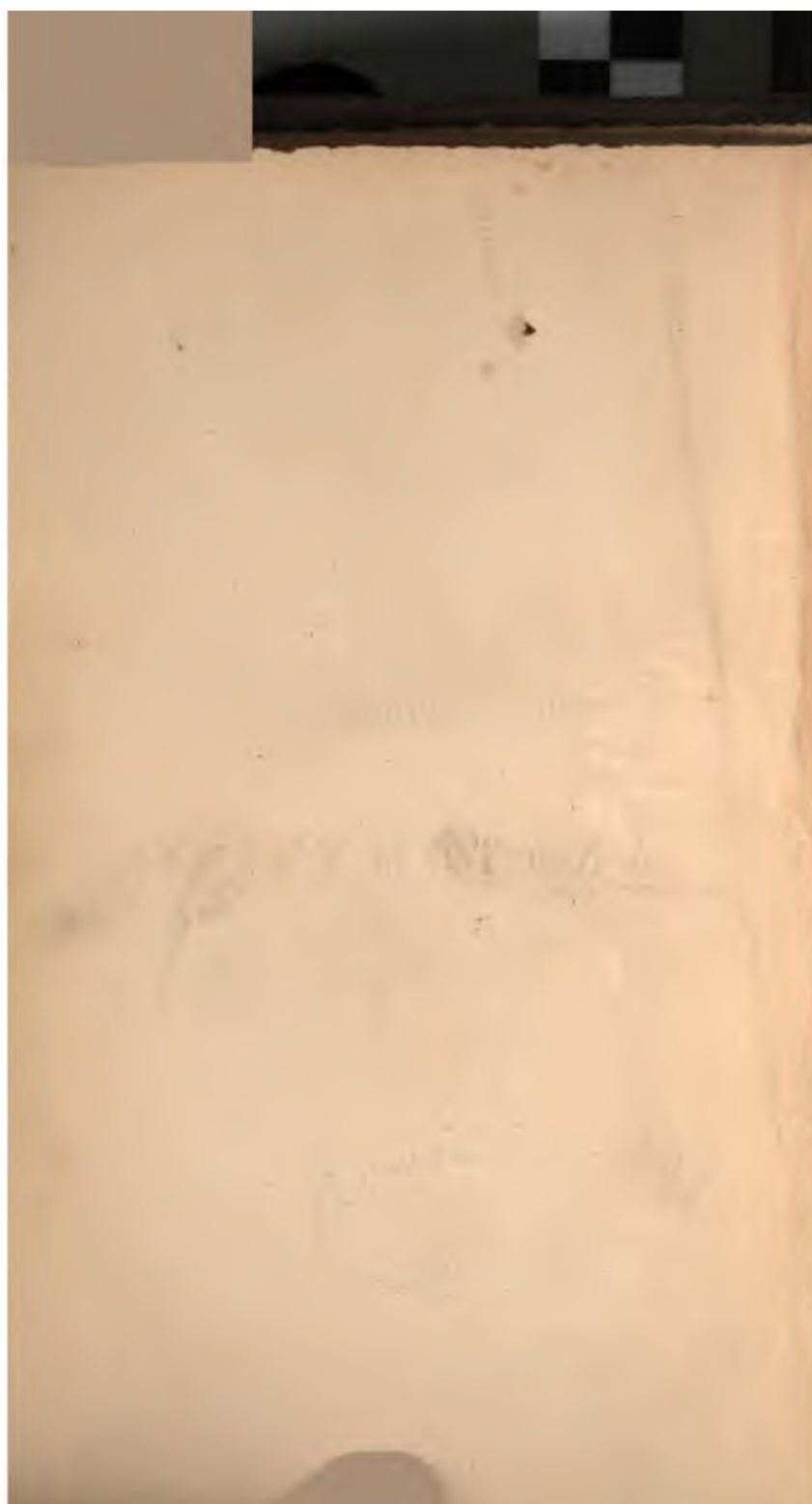


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DEMONSTRATIONS
OF
ANATOMY.



DEMONSTRATIONS
OF
ANATOMY;

BEING A
GUIDE TO THE KNOWLEDGE OF THE HUMAN BODY

BY
DISSECTION.

BY
GEORGE VINER ELLIS,
PROFESSOR OF ANATOMY IN UNIVERSITY COLLEGE, LONDON.

FIFTH EDITION, REVISED.

ILLUSTRATED BY 130 ENGRAVINGS ON WOOD.



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PREFACE.

THE original plan of this work is retained with as its usefulness has been established by trial years. It was devised for the purpose of teaching Anatomy by the dissection of the several parts of the Body in successive layers or stages in the following manner. In the examination of a part or region the attention of the student is directed first to its limits, to the surfaces of bone and muscle, and to the hollows and the situation of the subjacent vessels. The structures interposed between the surface and the bones are described in succession, with reference particularly to the position of the several objects and their connections with the surface, so that they may be observed in much the same manner as would be met with in an operation of surgery. The description of the whole is likewise arranged in accordance with the dissection in regions, and each blood vessel and other structure, is described only to such an extent as may be laid bare in the part under examination.

In this, as in other editions, I have endeavoured to make the work more complete by the correction of inaccuracies, as well as to render it more efficient, as a guide to dissection, by the introduction of such alterations as greater experience in teaching has shown to be desirable.

With the view of assisting the student in comprehending the detail of Anatomical Description, illustrations on wood have been inserted in this edition of my "Demonstrations of Anatomy." Some of the illustrations have been taken from the well-known plates of Messrs. Bourguery and Jacob, and from the accurate plates of Mr. Quain on the Surgical Anatomy of the Arteries. And most of the others have been obtained, by the kind permission of the Publishers, from blocks which were engraved originally for the purpose of illustrating Quain's Anatomy.

G. V. E.

UNIVERSITY COLLEGE LONDON,
Dec. 31, 1860.

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DEMONSTRATIONS OF ANATOMY.

CHAPTER I.

DISSECTION OF THE HEAD AND NECK.

SECTION I.

EXTERNAL PARTS OF THE HEAD.

DIRECTIONS.—In the dissection of the head and neck, the student should endeavour to learn the anatomy of the parts described in the first sixty pages before the first position of the body is changed; but should want of time necessitate an omission of some part, the examination of the facial nerve (p. 38) can be best deferred till a subsequent stage. The orbit on one side, and the posterior triangular space on both sides of the neck, as well as the objects on the exterior and interior of the head, should be examined whilst the body lies on the back in its first position.

Position.—The student may begin with the dissection of the scalp and the muscles of the ear. To obtain the best position, raise the head to a suitable height, and turn it to the right side. On the left side the muscles are to be seen, and on the opposite half the vessels and nerves are to be displayed.

EXTRINSIC MUSCLES OF THE EAR.—Three muscles attach the outer ear to the side of the head. Two are above it, one elevating, the other drawing it forwards; and the third, a retrahent muscle, is behind the ear. There are other special or intrinsic muscles of the cartilage of the ear, which will be afterwards described.

Dissection
of the upper
muscles,

Dissection.—When the ear has been drawn down by hooks, the position of the two upper muscles will be indicated by a slight prominence between it and the head; and the muscular fibres will be laid bare by means of the two following incisions, made no deeper than the skin:—One is to be carried upwards along the cutaneous ridge before mentioned and the side of the head, for about three inches; and the other, about the same length, is to be directed from before backwards close above the ear, so that the two may join at a right angle. On carefully raising the flaps of skin from below upwards, and removing a little subjacent tissue, the thin fan-shaped muscular layer will come into view—the more anterior fibres constituting the *attrahens*, and the posterior the *attollens aurem* muscle.

of the poste-
rior muscle.

On drawing forwards the ear, a ridge marks, in like manner, the situation of the posterior muscle. To remove the integuments, let the scalpel be drawn down, about an inch behind the ear, from the transverse cut above as far as to a level with the lobule of the ear, and then forwards below the lobule. After the piece of skin included by these cuts has been reflected towards the ear, the *retrahens* muscle will be easily found beneath the subcutaneous tissue, for it consists of rounded bundles of fibres, and is stronger though deeper than the others.

Attrahens
aurem
muscle

The *ATTRAHENS AUREM* is a small fan-shaped muscle, and arises from the fore part of the aponeurosis of the occipito-frontalis. Its fibres are directed backwards, and are inserted into a projection on the front of the rim of the ear. This muscle is united with the following at its origin, but a slight interval exists between them near their insertion. Beneath it are the temporal vessels.

is united
with next.

Attollens
aurem
muscle.

The *ATTOLLENS AUREM* has the same form as the preceding, though its fibres are longer and better marked. Arising also from the tendon of the occipito-frontalis, the fibres converge to their *insertion* into the inner or cranial surface of the pinna of the ear,—into an eminence corresponding with a fossa (that of the anti-helix) on the opposite aspect.

Retrahens
aurem con-
sists of two
or three
bundles.

The *RETRAHENS AUREM* (*musculi retrahentes*, Alb.) consists of two or three roundish but separate bundles of fibres, which are stronger than those of the other muscles. The bundles arise from the root of the mastoid process, and pass almost transversely forwards to be inserted by aponeurotic fibres into the lower part of the ear (concha) at its cranial aspect. The posterior auricular artery and nerve are in contact with this muscle.

The OCCIPITO-FRONTALIS MUSCLE covers the arch of the skull, and consists of an anterior and a posterior fleshy part, with an intervening tendon.

Dissection.—On the same side of the head (the left) the occipito-frontalis is to be dissected. To bring this muscle into view, a cut may be made along the middle line of the skull, from the root of the nose to a little below the occipital protuberance; and it may be connected in front with the transverse incision on the side of the head. The flap of skin, thus marked out, is to be raised from before and thrown backwards; whilst doing this the dissector will meet with first the anterior fleshy part of the muscle, next a white shining thin aponeurosis, and lastly the posterior fleshy belly towards the lateral aspect of the cranium. The student should bear in mind that the aponeurosis of the muscle is easily taken away with the granular fat superficial to it; and if the under surface of the flap of the integuments presents a white instead of a yellow appearance, he may suppose he is removing that aponeurosis.

The *anterior* or *frontal* part is a thin muscular layer over the os frontis, which is not connected to the subjacent bone, but mixes below with some muscles of the face. Along the line of the eyebrow (its *origin*) the fibres are blended with the orbicularis palpebrarum and corrugator supercillii, whilst opposite the nose they join the pyramidalis nasi muscle. From this attachment the fibres are directed upwards to the aponeurosis, and end in it rather below the level of the coronal suture.

The *posterior* or *occipital* part is stronger than the anterior; it arises from the mastoid portion of the temporal bone, and from the outer half or two-thirds of the upper curved line of the occipital bone. The fibres are about one inch and a half in length, and ascend to the aponeurosis.

The *tendon*, or epicranial aponeurosis, extends over the upper part of the cranium, and is continuous across the middle line with the same structure of the opposite half of the head. On the side it gives origin to the auricular muscles, and a thin membrane is here prolonged from it over the fascia covering the temporal muscle. Posteriorly, the aponeurosis is attached to the superior curved ridge of the occipital bone between the fleshy parts of the muscles of opposite sides. The aponeurotic expansion is closely attached to the skin; but it is connected to the pericranium only by a loose areolar tissue devoid of fat, so that it moves freely over the skull.

Occipito-frontalis.

Occipito-frontalis how seen :

care to be taken not to cut it away.

Frontal part:

Origin.

Ending.

Occipital part,

how attached.

Aponeurosis.

Its attachment.

integument is then to be raised from before backwards, but the subcutaneous fat should be left till the nerves are found. Behind the ear the skin should be raised as on the other side, to uncover the posterior auricular vessels and nerves.

Along the eyebrow seek the branches of vessels and nerves that come from the orbit, viz. the supra-orbital and frontal vessels, and the supra-orbital and supra-trochlear nerves. Seek nerves and vessels on the front ; They lie at first beneath the muscular fibres, and the student must cut through these to find them : the supra-orbital branches issue opposite the middle, and the supra-trochlear near the inner part of the orbit.

On the side of the head, in front of the ear, the superficial temporal vessels and nerves are to be found ; on the side of the head ; and somewhat above the zygoma are branches of the facial and superior maxillary nerves, whose offsets join. Behind the ear and below it, the posterior auricular vessels and nerve, and branches from the great auricular nerve to the tip and back of the ear, are to be seen ; one or more offsets of the last should be traced to their junction with the posterior auricular nerve.

At the back of the head the ramifications of the occipital vessels, with the large and small occipital nerves, should be at the back of the head. sought out ; the former nerve lies by the side of the artery, and the latter about midway between this vessel and the ear.

CUTANEOUS VESSELS.—The arteries of the scalp are furnished by the internal and external carotid arteries, and anastomose freely over the side of the head. Only two small branches, the supra-orbital and frontal come from the former ; whilst several, viz. the temporal, occipital, and posterior auricular arteries belong to the latter. Vessels of the scalp.

The *supra-orbital artery* leaves the orbit through the notch in the margin of the orbit, and is distributed on the forehead. Some of its branches are superficial to the occipito-frontalis, and ascend towards the top of the head, whilst others remain beneath the muscle, and supply it, the pericranium, and the bone. Supra-orbital artery.

The *frontal branch* is close to the inner angle of the orbit, and is much smaller than the preceding. It soon ends in branches for the supply of the muscles, integuments, and pericranium. Frontal artery.

The *superficial temporal artery* is one of the terminal branches of the external carotid. After ascending over the zygoma for about two inches, the vessel divides on the temporal fascia into anterior and posterior branches :— Superficial temporal has

- anterior and The *anterior branch* runs forward with a serpentine course to the forehead, supplying muscular, cutaneous, and pericranial offsets, and anastomoses with the supra-orbital artery. This is the branch that is opened when blood is taken from the temporal artery.
- posterior branch. The *posterior branch* is larger than the other, and arches backwards above the ear towards the occipital artery, with which it anastomoses. Its offsets are similar to those of the anterior branch, and it communicates moreover with the artery of the opposite side over the top of the head.
- Occipital artery. *Occipital artery*.—The terminal part of this artery, after perforating the trapezius, divides into large and tortuous branches, which spread over the back of the head and the occipito-frontalis muscle. Communications take place with the artery of the opposite side, with the posterior part of the temporal, and with the following artery. Some offsets pass deeply to supply the occipito-frontalis muscle, the pericranium, and the bone.
- Posterior auricular. The *posterior auricular artery* appears in front of the mastoid process, and divides into two branches. One (mastoid) is directed backwards to supply the occipito-frontalis, and anastomose with the occipital artery. The other (auricular) is furnished to the retrahent muscle and the back of the pinna of the ear; and an offset from it pierces the pinna to be distributed on the opposite surface.
- Veins of the scalp; The **VEINS** of the exterior of the head are so similar to the arteries, that a full notice of each is not required. All the veins corresponding with branches of the internal carotid artery enter the facial vein, whilst the rest open into the jugular veins. These superficial veins communicate both with the sinuses in the interior of the skull by means of small branches named *emissary*, and with the veins occupying the spongy substance (*diploë*) of the cranial bones.
- how they join other veins. The *frontal vein* is directed towards the inner angle of the orbit, where it receives the *supra-orbital vein*, the two giving rise to the angular vein of the face. Both the *superficial temporal* and *posterior auricular veins* open into the external jugular; and the *occipital* joins the internal jugular vein.
- Nerves of the scalp are **CUTANEOUS NERVES**.—The several nerves are furnished from the terminal parts of both the cranial and spinal nerves. The half of the head anterior to the ear receives branches from the three trunks of the fifth cranial nerve, and a few *offsets* from the facial nerve. All the rest of the head is

supplied by spinal nerves, from both their anterior and posterior primary branches, except close behind the ear, where there is an offset of the facial (seventh cranial) nerve.

The *supra-orbital nerve* comes from the first trunk of the fifth nerve, and escapes from the orbit with its companion artery; whilst beneath the occipito-frontalis muscle, the nerve gives offsets to this and the orbicularis palpebrarum, as well as to the pericranium. Finally, the nerve ends in two cutaneous branches, which ramify between the epicranial aponeurosis and the skin:—

One of these (inner) soon pierces the occipito-frontalis, and reaches upwards as high as the parietal bone. The other branch (outer) is of larger size, and perforating the muscle higher up, extends over the arch of the head to the os occipitis. Whilst the nerve is escaping from the supra-orbital notch it furnishes some *palpebral* filaments to the upper eyelid. In the orbicular muscle a communication is established between this and the facial nerve.

At the inner angle of the orbit is the small *supra-trochlear branch* of the same nerve. It turns upwards to the forehead close to the bone, and piercing the muscular fibres ends in the integument. Branches are given from it to the orbicularis and corrugator supercilii, and some *palpebral* twigs descend to the eyelid.

The *superficial temporal nerves* are derived from the second and third trunks of the fifth nerve, and from the facial nerve.

a. The *temporal branch* of the *superior maxillary nerve* (second trunk of the fifth) is usually a slender twig, which perforates the temporal aponeurosis about a finger's breadth above the zygoma. When become cutaneous, the nerve is distributed on the temple, and communicates with the facial nerve, also sometimes with the next.

b. The *auriculo-temporal branch* of the *inferior maxillary nerve* (third trunk of the fifth) is near the ear, and accompanies the temporal artery to the top of the head. As soon as the nerve emerges from beneath the parotid gland, it divides into two terminal branches:—the more posterior is the smaller of the two, and supplies the *attrahens aurem* muscle and the integument above the ear; the other branch ascends vertically to the top of the head, and is distributed over the epicranial and temporal aponeuroses. The nerve also furnishes an *auricular branch* (upper) to the anterior part of the ear, above the auditory meatus.

c. The *temporal branches* of the *facial nerve* are directed

Supra-orbital nerve;

its two cutaneous branches.

Supra-trochlear branch.

Temporal nerves;

from superior maxillary;

from inferior maxillary;

and from facial nerve.

upwards over the temporal aponeurosis to the orbicularis palpebrarum muscle. They will be described with the dissection of the trunk of the facial nerve.

Posterior
auricular
nerve has

The *posterior auricular nerve* lies behind the ear with the artery of the same name. It arises from the facial nerve close to the stylo-mastoid foramen, and ascends in front of the mastoid process. Soon after the nerve becomes superficial it communicates with the great auricular nerve, and divides into an occipital and an auricular branch, which are distributed as their names express :—

occipital
branch,

The *occipital branch* is long and slender, and ends in the posterior belly of the occipito-frontalis muscle. It lies near the occipital bone, enveloped in dense fibrous structure, and furnishes offsets to the integuments.

and auricu-
lar.

The *auricular branch* ascends to the back of the ear, supplying the retrahent muscle and the posterior surface of the pinna.

Great auri-
cular nerve.

The *great auricular nerve* of the cervical plexus is seen to some extent at the lower part of the ear, but its anatomy will be afterwards given with the description of the cervical plexus.

Great occipi-
tal nerve

The *great occipital* is the largest cutaneous nerve at the back of the head, and is recognised by its proximity to the occipital artery. Springing from the posterior primary branch of the second cervical nerve, it perforates the muscles of the back of the neck, and divides on the occiput into numerous large offsets ; these spread over the posterior part of the occipito-frontalis muscle, ending mostly in the integument, and one small *auricular* branch reaches the cranial aspect of the ear. As soon as the nerve pierces the trapezius, it is joined by an offset from the third cervical nerve ; and on the back of the head it communicates with the small occipital nerve.

gives an
auricular
branch.

Small occi-
pital nerve

The *small occipital nerve* of the cervical plexus lies midway between the ear and the preceding nerve, and is continued upwards in the integuments higher than the level of the ear. It communicates with the nerve on each side, viz. the posterior auricular and great occipital. Usually this nerve furnishes an *auricular* branch to the upper part of the ear at the cranial aspect, which supplies also the attollens aurem muscle.

has an
auricular
branch.

Dissection
to open the
skull.

Dissection.—The skull is now to be opened, but before sawing the bone the dissector should detach on the right side the temporal muscle nearly down to the zygoma, without separating the fascia covering it ; and all the remaining

soft parts should be divided by an incision carried around the skull, about one inch above the margin of the orbit at the forehead, and as low as the protuberance at the occiput.

The cranium is to be sawn in the same line as the incision through the soft parts, but the saw is to cut only through the outer osseous plate, and the inner plate is to be divided with a chisel, in order that the subjacent membrane of the brain (dura mater) may not be injured. The skull cap is next to be forcibly detached by inserting the fingers between the cut surfaces in front, and the dura mater will then come into view.

Precautions
in cutting
through the
bone.

SECTION II.

INTERNAL PARTS OF THE HEAD.

Directions.—It will be more advantageous for the student to proceed at once with the parts described in this *Section* than to examine the brain at this stage. Directions are given (p. 12) for the preservation of the brain, after its removal, till it can be dissected.

Course to be
followed.

The DURA MATER is the most external of the membranes investing the brain. It is a strong, fibrous structure, which serves as a periosteum to the bones, and supports the cerebral mass. Its outer surface is rough, and presents, now it is separated from the bone, numerous small fibrous and vascular processes; but these are most marked along the line of the sutures, where the attachment of the dura mater to the bone is much the most intimate. Ramifying on the upper part of the membrane are branches of the middle meningeal vessels, ascending towards the top of the head. Small granular fibrous bodies, glands of Pacchioni, are also seen along the middle line. The number of these bodies is very variable, and is increased with age. Occasionally the surface of the skull is indented by these so-called glands.

Dura mater.

Appearance
of outer
surface.

Dissection.—For the purpose of seeing the interior of the dura mater, divide this membrane with a scissors close to the margin of the skull, except in the middle line before and behind where the superior longitudinal sinus lies. The cut membrane is then to be raised towards the top of the brain; and on the right side the veins connecting it with the cerebral hemisphere may be broken through.

Cut through
the dura
mater.

When the dura mater has been cut through, its inner surface is seen to present a smooth and polished aspect; and

Inner
surface.

upwards over
palpebrarum m
section of the

Posterior
auricular
nerve has

The *posterior*
artery of the
close to the s
the mastoid pr
ficial it commu
divides into an
distributed as t

occipital
branch,

The *occipital*
posterior belly
the occipital be
furnishes offset

and auricu-
lar.

The *auricul*
supplying the r
the pinna.

Great auri-
cular nerve.

The *great au*
to some extent
will be afterwar
plexus.

Great occipi-
tal nerve

The *great occ*
back of the hea
occipital artery
branch of the
muscles of the
into numerous
part of the occ
integument, an
cranial aspect o
trapezius, it is
nerve ; and on
the small occipi

gives an
auricular
branch.

Small occi-
pital nerve

The *small occ*
way between th
tinued upwards
the ear. It cor
the posterior a
nerve furnishes
ear at the cran

has an
auricular
branch.

directed likewise from behind forwards, so that the current of the blood in them is evidently opposed to the current in the sinus. This disposition of the veins may be seen on the left side of the brain, where the parts are undisturbed.

Dissection.—Before the rest of the dura mater can be seen, the brain must be taken from the body. To facilitate its removal, let the head incline backwards, whilst the shoulders are raised on a block, so that the brain may be separated somewhat from the base of the skull. Cut across now the anterior part of the falx cerebri, and the different cerebral veins entering the longitudinal sinus; raise and throw backwards the falx, but leave it uncut behind, where it is connected with the rest of the dura mater. For the division of the nerves of the brain, a sharp scalpel will be necessary; and the nerves are to be cut longer on the one side than on the other.

Removal of the brain.—Begin the removal of the brain by gently raising with the fingers the anterior lobes and the olfactory bulbs. Next cut through the internal carotid artery and the second and third nerves, which first present themselves to the dissector; the large second nerve is on the inner, and the round third nerve on the outer side of the artery. A small branch of artery to the orbit should likewise be divided at this time. The brain is now to be supported in the left hand, and the pituitary body to be dislodged with the knife from the hollow in the centre of the sphenoid bone. Afterwards a strong horizontal process of the dura mater (tentorium cerebelli) comes into view; and along its free margin will be seen the small fourth nerve, which is to be cut at this stage of the proceeding. Next make an incision through the tentorium on each side, close to its attachment to the temporal bone, without injuring the parts underneath. The following nerves, which now appear, are to be divided in succession. Near the inner margin of the tentorium is the fifth nerve, consisting of a large and small root; whilst towards the middle line of the skull is the long slender sixth nerve. Below the fifth, and somewhat external to it, is the seventh nerve with its facial and auditory parts, the former being anterior and the smaller of the two. Directly below the seventh are the three trunks of the eighth nerve in one line:—of these, the upper small piece is the glosso-pharyngeal; the flat band next below, the pneumo-gastric; and the long round nerve ascending from the spinal canal, the spinal accessory. The remaining nerve is the ninth, which consists of two small pieces. After

Current of
blood in it.

Dissection
for removal
of brain.

Mode of pro-
ceeding, and
parts cut in
succession.

dividing the nerves, cut through the vertebral arteries, as they wind round the upper part of the spinal cord. Lastly, cut across the spinal cord as low as possible, as well as the roots of the spinal nerves that are attached on each side. By placing the first two fingers of the right hand in the spinal canal, the cord may be raised, and the whole brain may then be taken readily from the skull in the left hand.

How to preserve the brain.

Its preservation.—The brain may be immersed in spirit to harden the texture, and methylated spirit may be used on account of its cheapness. To allow the spirit to reach the interior of the ventricles, the upper part of each hemisphere is to be cut off nearly to the level of the corpus callosum; and then each lateral ventricle is to be opened by a longitudinal incision, about two inches long, near the inner margin of the divided hemisphere, and about midway from before back. Now, placing the brain upside down on a piece of calico long enough to wrap over it, set it aside in the spirit, together with the top of one hemisphere.

Examination of it.

Its examination.—At the end of one day the dissector should return to the examination of the other membranes and the vessels. As soon as the vessels have been learnt, the membranes are to be carefully removed from all the surface of the brain, without detaching the different cranial nerves. Finally, the brain may remain in the spirit till the dissection of the head and neck has been completed. The description of the brain will be found after that of the head and neck.

Its description where found.

Directions.

Directions.—After setting aside the brain, the anatomy of the dura mater, and the vessels and nerves in the base of the skull should be proceeded with. Let the head be raised to a convenient height, and the tentorium be fastened in its natural position with a few stitches. The dissector should be furnished with the base of a skull whilst studying the following parts.

Dura mater in base of skull;

Dura mater.—At the base of the cranium the dura mater is much more closely united to the bones than it is at the top of the skull. Here it dips into the different inequalities on the osseous surfaces: it also sends processes through the several foramina, which join for the most part the pericranium, and furnish sheaths to the nerves. Beginning the examination in front, the student will find the membrane sending a prolongation into the foramen cæcum, as well as a series of tubes through the apertures in the cribriform plate of the ethmoid bone. Through the sphenoidal fissure, a large process enters the orbit; and a covering is continued

its prolongations

on the optic nerve to the eyeball. After lining the sella Turcica, the dura mater adheres closely to the basilar process of the occipital bone; and it may be traced into the spinal canal through the foramen magnum, to the margin of which it is very firmly united.

The *tentorium cerebelli* is the piece of the dura mater that is interposed in a somewhat horizontal position between the cerebellum and the posterior part of the cerebrum. Its upper surface is raised along the middle, where it is joined by the falx cerebri, and is hollowed laterally for the reception of the back part of the cerebral hemispheres; its under surface touches the little brain, and is joined by the falx cerebelli. The anterior margin is free, except at the ends where it is fixed by a narrow slip to each anterior clinoid process. The posterior or attached part is connected to the following bones:—occipital (its transverse groove), inferior angle of the parietal, petrous portion of the temporal (upper border), and posterior clinoid process of the sphenoid. Along the centre of the tentorium is the straight sinus, whilst in the attached edge are the lateral and the superior petrosal sinuses.

Falx cerebri.—The characters of this fold have been given in p. 10.

The *falx cerebelli* has the same position below the tentorium as the falx cerebri above that fold. It is much smaller than the falx of the cerebrum, and will be seen by detaching the tentorium. Triangular in form, this fold is attached to the middle of the occipital bone, below the transverse ridge, and projects between the hemispheres of the cerebellum. Its base is directed to the tentorium, and the apex ends below, at the foramen magnum, to each side of which it gives a small slip. In it are contained the occipital sinuses.

The SINUSES are venous spaces between the layers of the dura mater, into which the blood is received. All the sinuses open either into a large space named torcular Herophili, opposite the occipital protuberance, or into the two cavernous sinuses by the sides of the body of the sphenoid bone.

A. The TORCULAR HEROPHILI (fig. 1, a,) is placed in the tentorium, opposite the centre of the occipital bone. It is of an irregular shape, and numerous sinuses open into it; viz. the superior longitudinal above, and the occipital below; the straight and inferior longitudinal in front, and the lateral sinus on each side.

Superior and The *superior longitudinal sinus* has been already described (see p. 10).
 Inferior longitudinal. The *inferior longitudinal sinus* (fig. 1, c) resembles a small vein, and is contained in the lower border of the falx

Fig. 1.*



cerebri at the posterior part. This vein receives blood from the falx and the larger brain, and ends in the straight sinus at the edge of the tentorium.

Straight
sinus.

The *straight sinus* (fig. 1, d) lies along the middle of the tentorium, and seems to continue the preceding sinus to the common point of union. Its form is triangular, like the superior longitudinal. Joining it are the inferior longitudinal sinus, the veins of Galen, e, from the interior of the large brain, and some small veins from the upper part of the small brain.

Occipital
sinus.

The *occipital sinus* (fig. 1, g) is a small space in the falx cerebelli, which reaches to the foramen magnum, and collects the blood from the occipital fossæ. This sinus may be double.

Lateral
sinus.

The *lateral sinus* (fig. 1, f) is the channel by which most of the blood passes from the skull. There is one on each side, right and left, which extends from the occipital protuberance to the foramen jugulare, where it ends in the

* Some of the sinuses of the skull. a. Torcular Herophili. b. Superior longitudinal sinus. c. Inferior longitudinal. d. Straight sinus. e. Veins of Galen. f. Lateral sinus. g. Occipital sinus. h. Superior, and i inferior petrosal sinus. k. Veins of the septum of the nose.

internal jugular vein. In this extent the sinus occupies the winding groove in the interior of the skull between the two points of bone before mentioned. Besides small veins from the brain, it is joined by the superior petrosal sinus opposite the upper border of the petrous portion of the temporal bone, and by the inferior petrosal at the foramen jugulare. Oftentimes it communicates with the occipital vein through the mastoid foramen, and sometimes with the veins of the diploë of the skull. The right sinus is frequently larger than the left.

Position to bone.

Sinuses joining it

The foramen jugulare is divided into three compartments by bands of the dura mater; through the posterior interval the lateral sinus passes, through the anterior the inferior petrosal sinus, and through the central one the eighth nerve.

Situation in the foramen jugulare.

Dissection.—To examine the cavernous sinus, say on the left side, let the dura mater opposite the body of the sphenoid bone be cut through from the anterior to the posterior clinoid process, and internal to the position of the third nerve. Behind the last-named process, let the knife be directed inwards for about half the width of the basilar part of the occipital bone. By placing the handle of the scalpel in the opening thus made, the extent of the space will be defined. A probe should be passed into the different sinuses that join the cavernous centre.

Dissection.

B. The CAVERNOUS SINUS, which has been so named from the reticulate structure in its interior, is situate on the side of the body of the sphenoid bone. This space, resulting from the separation of the layers of the dura mater, is of an irregular shape, and extends from the sphenoidal fissure to the tip of the petrous portion of the temporal bone. The piece of dura mater bounding the sinus externally is of some thickness, and contains in its substance the third and fourth nerves, with the orbital trunk of the fifth nerve. The cavity of the sinus is larger behind than before, and in it are shreds of fibrous tissue with small vessels. Through the space winds the trunk of the internal carotid artery surrounded by the sympathetic, with the sixth nerve on the outer side of the vessel; but all these are shut out from the blood in the space by the thin lining membrane. The cavernous sinus receives the ophthalmic vein of the orbit, some inferior cerebral veins, and twigs from the pterygoid veins outside the skull. It communicates with its fellow on the opposite side by the circular and transverse sinuses, and its blood is transmitted to the lateral sinus by the superior and inferior petrosal channels.

Cavernous sinus

has nerves in outer wall;

contains carotid artery and sixth nerve;

and is joined by the following sinuses, viz.

- Circular sinus,** The *circular sinus* lies around the pituitary body, and reaches from the one cavernous sinus to the other across the middle line. Besides serving as the means of communication between those sinuses, it receives small veins from the pituitary body. This sinus is usually destroyed by the removal of the pituitary body.
- Transverse sinus,** The *transverse* or *basilar sinus* crosses the basilar process of the occipital bone, on a level with the petrous part of the temporal bone, and joins the opposite cavernous sinuses. A second transverse sinus is sometimes found nearer the foramen magnum.
- Superior petrosal,** The *superior petrosal sinus* (fig. 1, *h*) lies in a groove in the upper margin of the petrous part of the temporal bone, and extends between the cavernous and lateral sinuses. A small vein from the cerebellum, and another from the internal ear, are received into it.
- Inferior petrosal.** The *inferior petrosal sinus* (fig. 1, *i*) extends between the same sinuses as the preceding, and lies in a groove along the line of junction of the petrous part of the temporal with the basilar process of the occipital bone; it is joined by a small vein from the outside of the skull, through the foramen lacerum at the base of the cranium. This sinus passes through the anterior compartment of the jugular foramen, and ends in the internal jugular vein.
- Arteries of dura mater are ;—** **MENINGEAL ARTERIES.**—The arteries supplying the dura mater and the cranium are found in the three fossæ of the base of the skull, and may be named from their situation, anterior, middle, and posterior meningeal.
- Anterior meningeal.** The *anterior meningeal* are two very small branches which come from the ethmoidal arteries (p. 48): they enter the skull by apertures between the frontal and ethmoid bones, and are distributed to the dura mater near the ethmoid bone.
- Middle meningeal,** The *middle meningeal* arteries are three in number: two, that are named large and small, are derived from the internal maxillary trunk; and the third is an offset of the ascending pharyngeal artery.
- from internal maxillary ;** *a.* The *large meningeal branch* of the internal maxillary artery enters the skull by the foramen spinosum of the sphenoid bone, and ascends towards the anterior inferior angle of the parietal bone. At this spot the vessel enters a deep groove in the cranium, and ends in ramifications that spread over the side of the head, some of these reaching to the top, and others towards the occiput. Two *veins* accompany this artery.

Branches.—As soon as the artery enters the cranial cavity, it furnishes branches to the dura mater and osseous structure, and to the ganglion of the fifth nerve. One small offset, *petrosal*, enters the hiatus Fallopii, and extends through the aqueduct of the same name till it meets the stylo-mastoid artery. One or two branches enter the orbit, and anastomose with the ophthalmic artery.

b. The *small meningeal* branch is an offset of the large one outside the skull, and is transmitted through the foramen ovale to the membrane lining the middle cranial fossa.

c. Another *meningeal* branch from the ascending pharyngeal artery appears in the middle fossa of the skull, after passing through the foramen lacerum (basis cranii).

The *posterior meningeal* branches are likewise small, and are furnished by the occipital and vertebral arteries.

Those from the occipital, one on each side, enter the skull by the jugular foramen; and those from the vertebral arise opposite the foramen magnum. Both sets ramify in the posterior fossa of the skull.

MENINGEAL NERVES.—The source of the nerves of the dura mater is very uncertain. Offsets to it are derived from both the cranial and sympathetic nerves. To make these nerves apparent, it would be necessary to steep the dura mater in diluted nitric acid.*

CRANIAL NERVES.—The cranial nerves pass from the encephalon through apertures in the base of the skull. As each leaves the cranium it is invested by processes of the membranes of the brain, which are thus disposed:—those of the dura mater and pia mater are lost on the nerve; whilst that of the arachnoid membrane is reflected back, after a short distance, to the interior of the skull. Some of the nerves, those in the middle fossa of the skull for instance, receive sheaths of the dura mater before they approach the foramina of transmission. For the present the nerves will be referred to as nine in number, but notice will be subsequently taken of a different mode of enumerating them.

Only part of the course of each nerve will be now seen, the rest must be learnt in the dissection of the base of the brain.

* Many of the cranial nerves are said to supply the dura mater; and the student who is desirous for further information may consult Professor Kölliker's *Mikroskopische Anatomie*, p. 495.

Olfactory
nerve,

ends in the
nose.

The FIRST NERVE ends anteriorly in the enlargement of the olfactory bulb. This swelling lies on the cribriform plate of the ethmoid bone, and supplies about twenty filaments to the nose through the small foramina in the subjacent bone. These delicate nerves are surrounded by prolongations of the membranes of the brain, whose disposition will be noticed in the dissection of the nose.

Optic nerve
enters the
eye.

The SECOND NERVE diverging from its commissure to the eyeball, enters the orbit through the optic foramen; accompanying the nerve is the ophthalmic artery.

Dissection
of third and
fourth
nerves;

Dissection.—The third, fourth, and the ophthalmic trunk of the fifth nerve lie in the outer wall of the cavernous sinus; and it will be necessary, in order to see them, to remove the sheaths of the dura mater they receive.

of fifth
nerve.

Afterwards the student should follow outwards the roots of the fifth nerve into the middle fossa of the skull, and take away the dura mater from the surface of the large Gasserian ganglion which lies on the point of the petrous portion of the temporal bone. Then the other two large trunks from the front of the ganglion, viz., superior and inferior maxillary, should be traced to their apertures of exit from the skull.

Motor oculi
nerve

The THIRD NERVE is destined for the muscles of the orbit. It enters the wall of the cavernous sinus near the anterior clinoid process, and is deprived at that spot of its tube of arachnoid membrane. In the wall of the sinus it is placed above the other nerves; but when it is about to enter the orbit through the sphenoidal fissure, it lies below the fourth and part of the fifth, and divides into two branches. Near the orbit this nerve is joined by one or two delicate filaments of the cavernous plexus (p. 21).

passes to
orbit.

Trochlear
nerve

The FOURTH NERVE courses forward, like the preceding, to one muscle in the orbit. It is the smallest of the nerves in the wall of the sinus, and is placed below the third; but as it is about to pass through the sphenoidal fissure it becomes higher than all the other nerves. In the wall of the sinus the fourth nerve is joined by twigs of the sympathetic, and it is sometimes united with the ophthalmic trunk of the fifth.

in the wall
of cavernous
sinus.

Trifacial
nerve has
two roots;

FIFTH NERVE.—This nerve is distributed to the face and head, and consists of two parts or roots—a large or sensory, and a small or motory. The two roots of the nerve pass together through an aperture in the dura mater into the middle fossa of the base of the skull (fig. 6, ¹). Immediately afterwards the larger root enters into the Gasserian

ganglion ; whilst the smaller root passes beneath the ganglion, without communicating with it, and joins only one of the three trunks derived from the ganglion. their arrangement.

The *ganglion of the root of the fifth nerve* (Gasserian ganglion) is placed in a depression on the point of the petrous part of the temporal bone. The upper surface of the ganglion is closely united to the dura mater, and presents a semi-lunar elevation, whose convexity looks forwards. Some filaments from the plexus of the sympathetic on the carotid artery enter its inner side. Gasserian ganglion on large root,

Branches.—From the front of the ganglion proceed the three following trunks :—The ophthalmic nerve is the first and highest, and is destined for the orbit and face. Next in order is the superior maxillary nerve, which leaves the skull by the foramen rotundum, and ends in the face below the orbit. And the last, or the inferior maxillary nerve, passes downwards through the foramen ovale to reach the lower jaw, the lower part of the face, and the tongue. If the ganglion be raised, the small root will be seen passing beyond it to enter the trunk of the inferior maxillary nerve. gives three branches.

In consequence of this partial blending of the roots, those branches of the ganglion that are unconnected with the smaller or motor root, viz. the ophthalmic and superior maxillary, are solely nerves of sensibility ; but the inferior maxillary, which is compounded of both roots, is a nerve of sensibility and motion, like a spinal nerve. It is not, however, the whole of the inferior maxillary nerve that has this double function, for the motor root is mixed almost exclusively with the part of the trunk which supplies the muscles of the lower jaw ; and it is, therefore, chiefly that small part of the nerve which possesses a twofold action, and resembles a spinal nerve. Difference in the use of the branches.

The *ophthalmic nerve* is the only one of the three trunks that needs a more special notice in this stage of the dissection. It enters the orbit through the sphenoidal fissure, and is continued through that space to the forehead. In form it is a flat band ; and in its course to the orbit the nerve is contained in the wall of the cavernous sinus, where it lies below the third and fourth nerves. In this situation it is joined by filaments of the cavernous plexus of the sympathetic, and gives a small *recurrent* filament to that part of the dura mater which forms the tentorium cerebelli (Arnold). Near the orbit it divides into three branches. (See p. 44). Ophthalmic nerve of ganglion enters orbit

supplies dura mater in its course

Abducens
nerve is in
cavernous
sinus.

The SIXTH NERVE enters the orbit through the sphenoidal fissure, and supplies one of the orbital muscles. It pierces the dura mater behind the body of the sphenoid bone, and crosses the space of the cavernous sinus in its course to the orbit, instead of lying in the outer wall of the sinus with the other nerves. In the sinus the nerve is placed close against the outer side of the carotid artery; and it is joined by one or two branches of the sympathetic nerve surrounding that vessel.

Seventh
nerve has
two parts.

SEVENTH NERVE.—This cranial nerve consists of two trunks, facial and auditory, and both enter the meatus auditorius internus. In the bottom of the meatus they separate; the facial nerve courses through the aqueduct of Fallopius to the face, whilst the auditory nerve is distributed to the internal ear.

Eighth
nerve has
three parts.

EIGHTH NERVE.—Three trunks are combined in the eighth cranial nerve of Willis, viz. glosso-pharyngeal, pneumo-gastric, and spinal accessory. All three pass through the central compartment of the foramen jugulare, but all are not contained in one tube of either the dura mater or the arachnoid membrane. The glosso-pharyngeal nerve is external to the other two, being separated from them by the inferior petrosal sinus, and has distinct sheaths of the dura mater and the arachnoid membrane; but the pneumo-gastric and spinal accessory nerves are inclosed in the same tube of the dura mater, only a piece of the arachnoid intervening between them.

Their pas-
sage through
foramen
jugulare.

Ninth nerve.

The NINTH NERVE is the motor nerve of the tongue, and consists of two small pieces, which pierce separately the dura mater opposite the anterior condyloid foramen; these unite after passing through that aperture.

Dissection
of carotid,

Dissection.—The dissector may now return to the examination of the trunk of the carotid artery, as it winds through the cavernous sinus.

of sym-
pathetic plex-
uses.

On the opposite side, viz. that on which the nerves in the wall of the cavernous sinus are untouched, an attempt may be made to find two small plexuses of the sympathetic on the carotid artery. One of these (cavernous) is on the artery near the root of the anterior clinoid process; and to bring it into view it will be necessary to cut off that piece of bone, and to dissect out with care the third, fourth, fifth, and sixth nerves, looking for filaments between them and the plexus. Another plexus (carotid), joining the fifth and sixth nerves, surrounds the artery as this enters the sinus. In an injected body this dissection is scarcely possible.

The INTERNAL CAROTID ARTERY appears in the base of the skull at the apex of the petrous part of the temporal bone. In its ascent to the brain the vessel lies in the space of the cavernous sinus, along the side of the body of the sphenoid bone, and makes two remarkable bends, so as to look like the letter S reclined. On entering the sinus, the artery ascends at first to the posterior clinoid process; it is then directed forwards to the root of the anterior process of the same name; and lastly it turns upwards internal to this point of bone, perforates the dura mater bounding the sinus, and divides into cerebral arteries at the base of the brain. In this course the artery is enveloped by nerves derived from the sympathetic in the neck.

Internal carotid artery,

winds through cavernous sinus.

The branches of this part of the artery are few. In the sinus there are some small arteries (*arteriæ receptaculi*) for the supply of the dura mater and the bone, the nerves, and the pituitary body; and opposite the anterior clinoid process the ophthalmic branch arises. The terminal branches of the carotid will be seen in the dissection of the base of the brain.

The branches are to dura mater and orbit.

SYMPATHETIC NERVE.—Around the carotid artery is a prolongation of the sympathetic nerve of the neck, which forms the following plexuses:—

Sympathetic on carotid forms

The carotid plexus is situate on the outer side of the vessel, at its entrance into the cavernous sinus, and communicates with the sixth nerve, and with the Gasserian ganglion.

carotid plexus,

The cavernous plexus is placed below the bend of the artery, which is close to the root of the anterior clinoid process. This small plexus is more immediately connected with the offset of the upper cervical ganglion of the sympathetic, which courses along the inner side of the carotid artery. Filaments are given from this plexus to unite with the third, fourth, and ophthalmic nerves. One filament is also furnished to the lenticular ganglion, either separately from, or in conjunction with the nasal nerve.

cavernous plexus.

Union with cranial nerves.

After forming these plexuses, the nerves surround the trunk of the carotid, and are lost chiefly in the cerebral membrane named pia mater.

Distribution.

Petrosal nerves.—Beneath the Gasserian ganglion is the large superficial petrosal nerve, entering the hiatus Fallopii to join the facial nerve. External to this is occasionally seen another small petrosal nerve (*external superficial*), which springs from the sympathetic on the middle meningeal artery, and enters the bone to join the facial nerve with the

Three petrosal nerves.

Two seen in base of skull.

preceding. A third, the *small petrosal* nerve, is contained in the substance of the temporal bone.

Directions
for preser-
vation of
parts.

Directions.—The source and the connections of these small nerves will be afterwards learnt. It will suffice now for the student to note them, and to see that they are kept moist and preserved fit for examination at a future time. Now the base of the skull has been examined, a preservative fluid should be applied, and the flaps of integuments should be stitched together over all.

SECTION III.

DISSECTION OF THE FACE.

Directions.

Directions.—The left side of the face may be used for the muscles and vessels, and the right side is to be reserved for the nerves.

Position of
body.

Position.—The previous position of the body for the examination of the base of the skull will require to be changed. The head is to be lowered, and the side of the face to be dissected is to be placed upwards.

Dissection.

Dissection.—As a preparatory step, the muscular fibres of the eyelids, lips, and side of the nose, are to be made slightly prominent by inserting a small quantity of tow or cotton wool into the different apertures.

How to
raise the
skin

The integument is to be removed from the left side of the face by means of the following incisions:—one is to be made in front of the ear, from above the zygoma to the angle of the jaw; and another is to be continued from the last point along the base of the jaw to the chin. The flap of skin is to be raised from behind forwards, and left adherent along the middle line. Much care must be taken in detaching the skin from the thin, and oftentimes pale fibres of the orbicular muscle of the eyelids, otherwise these will be cut away in consequence of the little areolar tissue that intervenes between the two. On the side of the nose the skin is closely united to the subjacent parts, and must be detached with caution. Around the mouth are also many fleshy slips that extend both upwards and downwards from the orbicular muscle, but they are all marked so distinctly as to escape injury, except the small risorius muscle that comes from the angle of the lower jaw towards the corner of the mouth. When removing the fat from these muscles, each fleshy slip may be made tense with hooks.

from muscle
of eyelid,

side of nose,

and around
mouth.

The facial vessels and their branches will come into view as the parts are cleaned ; but the nerves may be disregarded on this side. Facial vessels

Near the ear is the parotid gland, whose duct is to be preserved ; this is on a level with the meatus auditorius, and pierces the middle of the cheek. and parotid gland.

MUSCLES OF THE FACE.—The superficial muscles of the face are gathered around the apertures of the eye, nose, and mouth. An orbicular or sphincter muscle surrounds the apertures of both the eye and mouth ; and other muscles are blended with each to enlarge the opening in the centre of the fibres. There are three distinct groups of muscles : one of the opening of the eyelids ; another of the nostril ; and a third of the aperture of the mouth. One of the muscles of mastication, viz. the masseter, is also now seen, but it will be afterwards examined. In the face the muscles surround the apertures.

MUSCLES OF THE EYELIDS.—The muscles of the eyelids are four in number, viz. orbicularis palpebrarum, corrugator supercilii, levator palpebræ superioris, and tensor tarsi.* The two latter are dissected in the orbit, and will be described with that part. Four muscles of eyelids.

The **ORBICULARIS PALPEBRARUM** is the sphincter muscle closing the elliptical opening between the eyelids. It is a flat and thin layer, which extends from the margin of the lids beyond the circumference of the orbit. From a difference in the characters of the fibres, a division has been made of them into two parts—outer and inner. Orbicularis palpebrarum.
Division into two parts.

The external fibres (orbital part), the best marked, are fixed only at one point, viz. the inner angle of the orbit. This attachment (origin) is connected with the surface and borders of the small tendo palpebrarum or tarsal ligament ; above that tendon with the nasal process of the upper maxillary bone, and the internal angular process of the frontal bone ; and below the tendon with the superior maxillary bone, and the inner part of the margin of the orbit. From this origin the fibres are directed outwards, giving rise to ovals, which lie side by side, and increase in size towards the outer margin of the muscle, where they project beyond the margin of the orbit. Orbital or external attached internally.

The internal fibres (palpebral part), paler and finer than Internal or

* The tensor tarsi muscle (p. 51) is sometimes described as part of the orbicularis.

palpebral part, attached internally and externally. Ciliary bundle. the outer, occupy the eyelids, and are fixed at both the outer and inner angles of the orbit. Internally (origin) they are united with the tendo palpebrarum, and externally (insertion) with the external tarsal ligament and the malar bone, and some few may blend with the orbital part. Close to the cilia or eyelashes the fibres form a small pale bundle, which is sometimes called *ciliary*.

Connection with parts around. The muscle is subcutaneous, and its circumference is free, except above, where it is blended with the occipito-frontalis. Beneath the upper half of the orbicularis, as it lies on the margin of the orbit, is the corrugator supercilii muscle with the supra-orbital vessels and nerve; and beneath the lower half is part of the elevator of the upper lip. The outer fibres are joined occasionally by slips to the other contiguous muscles below the orbit.

Corrugator supercilii. The CORRUGATOR SUPERCILII is found beneath the orbicularis, near the inner angle of the orbit. Its fibres arise from the inner part of the superciliary ridge of the frontal bone, and are directed thence outwards to join the orbicular muscle about the middle of the orbital arch. It is a short muscle, and is distinguished by the closeness of its fibres.

Four muscles of nose. MUSCLES OF THE NOSE.—The muscles of the nose are the following: pyramidalis nasi, compressor naris, levator alae nasi, with some fibres that dilate the nostril, and depressor alae nasi.

Pyramidalis nasi is over nasal bone. The PYRAMIDALIS NASI (fig. 2, ¹) is a small pyramidal slip that covers the nasal bone, and appears to be a prolongation of the occipito-frontalis muscle. Over the cartilaginous part of the nose its fibres end in an aponeurosis, which joins part of the compressor naris. Along its inner border is the muscle of the opposite side.

Compressor naris. COMPRESSOR NARIS.—This muscle (fig. 2, ³) is not well seen till after the examination of the following one. Triangular in shape, it arises by a point from the canine fossa of the upper maxillary bone. The fibres are directed inwards, spreading out at the same time, and end in an aponeurosis, which covers the cartilaginous part of the nose, and joins the tendon of the opposite muscle. This muscle is partly concealed by the next one—the common elevator of the ala of the nose and the upper lip.

Elevator of wing of nose. The LEVATOR LABII SUPERIORIS ALAQUE NASI (fig. 2, ²) is placed by the side of the nose, and arises from the nasal process of the upper maxillary bone, internal to the attachment of the orbicularis. As the fibres descend from the

inner part of the orbit, the most internal are attached by a narrow slip to the wing of the nose, whilst the rest are blended inferiorly with those of the orbicularis oris. Near its origin the muscle is partly concealed by the orbicularis palpebrarum, but in the rest of its extent it is subcutaneous. Its outer border joins the elevator of the upper lip.

Dilatator Naris. — In the dense tissue on the outer side of the nostril, are found a few muscular fibres both at the fore and back part of that aperture (fig. 2, ⁴, and ⁵), to which the above name has been given by Theile: they are seldom visible without a lens. The *anterior* slip passes from the cartilage of the aperture to the integument of the margin of the nostril; and the *posterior* arises from the upper jawbone and the small sesamoid cartilages and ends also in the integuments of the nostril.

The *DEPRESSOR ALÆ NASI* (fig. 2, ⁶) is found beneath the mucous membrane on the side of the frænum of the upper lip. It arises below the nose from a depression of the upper jawbone before the roots of the second incisor and canine teeth; and ascends to be inserted into the septum nasi and the posterior part of the ala of the nose.

MUSCLES OF THE MOUTH.—The muscles acting on the aperture of the mouth consist of a sphincter; an elevator of the upper lip, and of the angle of the mouth; depressors of the lower lip, and of the angle of the mouth, with an elevator of the lower lip; together with other small muscles that act on the corner, viz. zygomatici and risorius of Santorini. Lastly, the buccinator muscle may be reckoned in this set, as it acts indirectly on the corner of the mouth.

The *ORBICULARIS ORIS* MUSCLE surrounds the external opening of the mouth, and is constructed for the most part by the fibres of the several muscles acting on that aperture.

* Muscles of the nose and mouth. 1. Pyramidalis nasi. 2. Common elevator of the nose and lip. 3. Compressor naris. 4 and 5. The two slips of the dilatator naris. 6. Depressor alæ nasi. 7* and 7. Orbicularis palpebrarum.

Fig. 2.*



- consists of two parts, It consists of two parts, inner and outer, which differ much in the appearance and arrangement of the fibres.
- inner or circular, The *inner* part (fig. 2, ¹), whose fibres are pale in colour and fine in texture, forms a rounded thick fasciculus, which reaches outwards from the margin of the lip to the arch of the coronary artery. The fibres of this portion of the muscle are unattached to bone, and some pass from lip to lip round the corner of the mouth.
- not fixed to bone. The *outer* part is thin, wide, and more irregular in form, and has an attachment to the subjacent bone, besides its connection with the adjacent muscles. In the upper lip it is attached, on each side of the middle line, by one slip (nasolabial) to the back of the septum of the nose (fig. 2, ^{2*}), and by another to the outer surface of the alveolar margin of the upper jaw, opposite the canine and incisor teeth, external to the depressor of the wing of the nose. And in the lower lip it is fixed on each side into the inferior jawbone, on the outer aspect, opposite the canine tooth, or external to the levator labii inferioris muscle. To see these attachments the lip must be everted, and the mucous membrane carefully raised.
- Outer irregular, The inner margin of the muscle is free, and bounds the aperture of the mouth; whilst the outer edge blends with the different muscles that elevate or depress the lips and the angle of the mouth. Beneath the orbicularis in each lip is the coronary artery, with the mucous membrane and the labial glands.
- fixed to the nose and to the jawbones. The inner margin of the muscle is free, and bounds the aperture of the mouth; whilst the outer edge blends with the different muscles that elevate or depress the lips and the angle of the mouth. Beneath the orbicularis in each lip is the coronary artery, with the mucous membrane and the labial glands.
- Connections: blends with other muscles. The inner margin of the muscle is free, and bounds the aperture of the mouth; whilst the outer edge blends with the different muscles that elevate or depress the lips and the angle of the mouth. Beneath the orbicularis in each lip is the coronary artery, with the mucous membrane and the labial glands.
- Elevator of upper lip. The LEVATOR LABII SUPERIORIS extends *vertically from the lower margin of the orbit to the orbicularis oris. It arises from the upper maxillary and malar bones, above the infra-orbital foramen, and blends with the orbicularis oris between the middle line and the angle of the mouth. Near the orbit the muscle is overlapped by the orbicularis palpebrarum, but below that spot it is subcutaneous. By its inner side it joins the common elevator of the ala of the nose and upper lip; and to its outer side lie the zygomatic muscles, the small one joining it. Beneath it are the infra-orbital vessels and nerve.
- passes from the orbit to mouth. The LEVATOR LABII SUPERIORIS extends *vertically from the lower margin of the orbit to the orbicularis oris. It arises from the upper maxillary and malar bones, above the infra-orbital foramen, and blends with the orbicularis oris between the middle line and the angle of the mouth. Near the orbit the muscle is overlapped by the orbicularis palpebrarum, but below that spot it is subcutaneous. By its inner side it joins the common elevator of the ala of the nose and upper lip; and to its outer side lie the zygomatic muscles, the small one joining it. Beneath it are the infra-orbital vessels and nerve.
- Connections. The LEVATOR LABII SUPERIORIS extends *vertically from the lower margin of the orbit to the orbicularis oris. It arises from the upper maxillary and malar bones, above the infra-orbital foramen, and blends with the orbicularis oris between the middle line and the angle of the mouth. Near the orbit the muscle is overlapped by the orbicularis palpebrarum, but below that spot it is subcutaneous. By its inner side it joins the common elevator of the ala of the nose and upper lip; and to its outer side lie the zygomatic muscles, the small one joining it. Beneath it are the infra-orbital vessels and nerve.
- Depressor of lower lip. The DEPRESSOR LABII INFERIORIS is opposite the elevator of the upper lip, and has much yellow fat mixed with its fibres. The muscle takes its *origin* from a depression on the front of the lower jaw, reaching backwards from near the symphysis to a little beyond the hole for the labial vessels and nerve; ascending thence it is blended with the orbicularis in the lower lip. Its inner border joins the
- is in the

muscle of the opposite side, and its outer is overlapped by the depressor anguli oris. middle of chin.

The *LEVATOR LABII INFERIORIS* is a small muscle on the side of the frænum of the lower lip, which is opposite to the depressor of the ala of the nose in the upper lip. When the mucous membrane has been removed, this muscle will be seen to arise from a fossa near the symphysis of the lower jaw, and to descend to its insertion into the integument of the chin. Its position is internal to the depressor of the lip, and the attachment of the orbicularis. Elevator of chin is seen inside mouth.

The *LEVATOR ANGULI ORIS* has well-marked fibres, and is partly concealed by the preceding muscle. Arising from the canine fossa, beneath the infra-orbital foramen, its fibres spread out towards the angle of the mouth where they are superficial to the buccinator, and mix with the rest of the muscles, but the greater number are continued into the depressor anguli oris and the lower lip. Elevator of the angle mixes with depressor of angle.

The *DEPRESSOR ANGULI ORIS* is triangular in shape, and passes from the oblique line on the outer surface of the lower jaw to the angle of the mouth, where its fibres are continued into the elevator of the angle. This muscle conceals the labial branch of the inferior dental vessels and nerve. At its origin the depressor is united with the platysma myoides, and at its insertion with the risorius muscle. Depressor of angle is a strong muscle.

The *ZYGOMATIC MUSCLES* are directed obliquely from the arch of the same name towards the angle of the mouth. One is longer and larger than the other; hence the names major and minor. Zygomatic muscles;

The *zygomaticus major* arises from the outer part of the malar bone at the union with the temporal, and is inserted into the angle of the mouth. large

The *zygomaticus minor* is attached to the malar bone anterior to the other, and blends with the fibres of the special elevator of the upper lip. and small.

The *RISORII* MUSCLE (Santorini) is a thin and narrow bundle of fibres, sometimes divided into two or more parts, which arises externally from the fascia over the masseter muscle, and is connected internally with the apex of the depressor anguli oris. Risorius muscle is almost transverse.

The *BUCCINATOR* is a flat and wide muscle (fig. 11, ⁴), which occupies the interval between the jaws, and bounds in this direction the cavity of the mouth. The muscle arises from the outer surface of the alveolar borders of the upper and lower maxillæ, as far forward in each as the first molar tooth; and in the interval between the jaws it is attached Buccinator muscle. Origin.

Insertion at corners of the mouth.	to a band of fascia—the pterygo-maxillary ligament. From this origin the fibres are directed forwards to the angle of the mouth, where they mix with the other muscles and with both parts of the orbicularis; and as some of the central fibres descend to the lower lip whilst others ascend to the upper lip, a decussation takes place at the corner of the mouth. On the cutaneous surface of the buccinator are the different muscles that converge to the angle of the mouth; and crossing the upper part is the duct of the parotid gland, which perforates the muscle opposite the second upper molar tooth. Internally the muscle is lined by the mucous membrane of the mouth, and externally it is covered by a fascia that is continued to the pharynx. By its intermaxillary origin the buccinator corresponds with the attachment of the superior constrictor of the pharynx.
Parts in contact with it.	
Arteries of the face.	The VESSELS OF THE FACE consist of the facial and transverse facial arteries with their accompanying veins. The arteries are branches of the external carotid; and the facial vein is received into the internal jugular trunk.
Facial artery;	The <i>facial artery</i> emerges from the neck, and appears on the lower jaw, anterior to the masseter muscle. From this point the artery ascends in a tortuous manner, near the angle of the mouth and the side of the nose, to the inner angle of the orbit, where it anastomoses with the ophthalmic artery. The course of the vessel is comparatively superficial, though lying in the mass of fat of the inner part of the cheek. At first the artery is concealed by the platysma whilst crossing the jaw, but this thin muscle does not prevent pulsation being recognised during life; and near the mouth the large zygomatic muscle is superficial to it. The vessel rests successively on the lower jaw, buccinator muscle, elevator of the angle of the mouth, and elevator of the upper lip. Accompanying the artery is the facial vein, which is nearly a straight tube, and lies to its outer side.
course, and connections.	
Plan of the branches.	<i>Branches.</i> —From the outer side of the vessel unnamed branches are furnished to the muscles and integuments, some of which anastomose with the transverse facial artery. From the inner side are given the following branches :—
Inferior labial.	1. The <i>inferior labial branch</i> runs inwards beneath the depressor anguli oris muscle, and is distributed between the lower lip and chin; it communicates with the inferior coronary, and with the labial branch of the inferior dental artery.
Transverse	2. <i>Coronary branches.</i> —There is one for each lip (superior and inferior), which arise together or separately from the

facial, and are directed inwards between the orbicular muscle and the mucous membrane of the lip, till they inosculate with the corresponding branches of the opposite side. From the arterial arches thus formed, offsets are supplied to the lips and labial glands. From the arch in the upper lip a branch is given to the septum of the nose,—*artery of the septum*. form an arch in the lips. Branch to nose.

3. The *lateral nasal branch* arises opposite the ala of the nose, and passes beneath the levator labii superioris alaeque nasi to be distributed on the side of the nose, where it anastomoses with the nasal branch of the ophthalmic artery. Lateral nasal branch.

4. The *angular branch* is the terminal twig of the facial artery at the inner angle of the orbit, and joins with a branch of the ophthalmic artery. Angular branch.

The *facial vein* commences at the root of the nose by a small vein named angular (p. 6). It then crosses over the elevator of the upper lip, and separating from the artery courses beneath the large zygomatic muscle to the side of the jaw. Afterwards it has a short course in the neck to join the internal jugular vein. Facial vein is away from artery;

Branches.—At the inner side of the orbit it receives veins from the lower eyelid (inferior palpebral) and the side of the nose. Below the orbit it is joined by the infra-orbital vein, also by a large branch that comes from the pterygoid region (anterior internal maxillary); and thence to its termination by veins corresponding with the branches of the artery both in the face and neck. is joined by some branches.

The *transverse facial* is a branch of the temporal artery, and appears in the face at the anterior border of the parotid gland. It lies by the side of the parotid duct, with branches of the facial nerve, and distributes offsets to the muscles and integuments; some branches anastomose with the facial artery. Transverse facial artery.

Dissection.—The parotid gland may be next displayed. To see the gland, raise the skin from the surface towards the ear by means of a cut from the base of the jaw to the anterior border of the sterno-mastoid muscle; this cut may be united with that made for the dissection of the posterior muscle of the ear. A strong fascia covers the gland, and is connected above and behind to the zygoma and the cartilage of the ear, but in front is continued over the face. After the fascia has been removed, the superficial connections of the gland will appear. The great auricular nerve will be seen ascending to the lobe of the ear. Lay bare the parotid.

The PAROTID (fig. 10, ¹⁰), is the largest of the salivary Parotid gland.

glands ; it occupies the space between the ear and the lower jaw, and is named from its position. Its excretory duct enters the mouth through the middle of the cheek.

Irregular in shape ;

The shape of the gland is irregular, and is determined somewhat by the bounding parts. Thus inferiorly, where there is not any resisting structure, the parotid projects into the neck, and comes into close proximity with the sub-maxillary gland, though separated from it by a process of the cervical fascia ; a line from the angle of the jaw to the sterno-mastoid muscle marks usually the extent of the gland in this direction. Above, the parotid is limited by the zygoma and the temporal bone. Along the posterior part the sterno-mastoid muscle extends ; but anteriorly the gland projects somewhat on the face, and has a small accessory part, *socia parotidis*, which is prolonged from it over the masseter.

is lodged between the jaw and ear ;

accessory part.

The duct crosses side of face to reach mouth.

Connected with the anterior border is the excretory duct —duct of Stenson (*ductus Stenonis*), which crosses the masseter below the *socia parotidis*, and perforates the cheek obliquely opposite the second molar tooth of the upper jaw. The duct lies between the transverse facial artery and branches of the facial nerve, the latter being below it. A line drawn from the meatus auditorius to a little below the nostril would mark the level of the duct in the face, and the central point of the line would be opposite the opening into the mouth. The length of the duct is about two inches and a half, and its capacity is about equal to a crow-quill, but the opening into the mouth is only large enough to allow a small probe to pass.

its length and size.

Cutaneous surface of gland.

The cutaneous surface of the parotid is smooth, and has one or two lymphatic glands seated on it ; but from the deep part processes are sent into the inequalities of the space between the jaw and the mastoid process.

Dissection to see deep parts.

Dissection.—By removing with caution the parotid gland, the hollows that it fills up will come into view : at the same time the dissector will see the vessels and nerves that pass through the gland. An examination of the processes of the gland, and of the number of important vessels that are in relation with it, will demonstrate the impossibility of completely removing this body, and the dangers attending any operation on it. The duct may be now opened, and a probe passed along it to the mouth to show the diminished size of its aperture.

Deep part sinks behind jaw.

Two large processes of the gland extend deeply into the neck. One dips behind the styloid process, and projects



beneath the mastoid process and sterno-mastoid muscle, whilst it reaches also the deep vessels and nerves of the neck. The other piece is situate in front of the styloid process ; it passes into the glenoid hollow behind the articulation of the lower jaw, and beneath the ramus of that bone along the internal maxillary artery.

Passing through the middle of the gland is the external carotid artery, which ascends behind the ramus of the jaw, and furnishes the auricular, superficial temporal, and internal maxillary branches. Superficial to the artery is the trunk formed by the junction of the temporal and internal maxillary veins, from which the external jugular vein springs ; and opening into this common trunk are some veins from the parotid, whilst a branch through the gland connects it with the internal jugular vein.* Crossing the gland from behind forwards is the trunk of the facial nerve, which passes over the artery, and distributes its branches through the parotid. The superficial temporal branch of the inferior maxillary nerve likewise lies above the upper part of the glandular mass ; and offsets of the great auricular nerve pierce the gland at the lower part, and join the facial.

Vessels and nerves in the gland.

The *structure* of the parotid resembles that of the other salivary glands. The glandular mass is divided into numerous small lobules by intervening processes of fascia ; and each lobule consists of a set of the closed saccular extremities of the excretory duct, which are lined by flattened and nucleated epithelium, and surrounded by capillary vessels. The size of these little sacs, which by their aggregation form the mass of the lobule, is about $\frac{1}{1200}$ of an inch in diameter.

The gland formed by termination of the ducts,

From the lobules issue small ducts, which unite to form larger tubes, and finally all the ducts of the gland are collected into one. An examination of the common duct (duct of Stenson) will show it to be composed of an external thick fibrous coat, and of an internal mucous coat which is covered with columnar epithelium.

and the duct has two coats.

The parotid receives its arteries from the external carotid ; and its nerves from the sympathetic, auriculo-temporal of

Vessels and nerves.

* Oftentimes a different arrangement of these veins will be found. In such case the external jugular is continued from the occipital (half or all) and posterior auricular veins ; whilst the temporal and internal maxillary veins unite to form a trunk (temporo-maxillary), which receives the facial below the jaw, and opens into the internal jugular vein opposite the upper border of the thyroid cartilage. When this condition exists, the temporo-maxillary trunk accompanies the external carotid artery.

the fifth, facial, and great auricular. Its lymphatics join those of the neck.

Molar glands.

Two or three small *molar* glands lie along the origin of the buccinator, and open into the mouth near the last molar tooth by separate ducts.

Nasal cartilages.

CARTILAGES OF THE NOSE.—These close the anterior nasal aperture in the skeleton, and form part of the outer nose and the septum. They are five in number, two on each

Fig. 3.*



Take away tissue from surface.

The upper cartilage touches its fellow in the middle.

The lower cartilage surrounds aperture. One part outside;

side—lateral cartilage and cartilage of the aperture; together with a central one, or the cartilage of the septum of the nose. Only the lateral cartilages are seen in this stage of the dissection.

Dissection.—The lateral cartilages will be seen when all the muscular and fibrous structure of the left side of the nose, and the skin of the lower part of the nostril of the same side, have been taken away. By passing the knife deeply in the middle line, the cartilage of the septum will be rendered apparent between the lateral cartilages of each side.

The *upper lateral cartilage* (fig. 3, ¹) is flattened, and is somewhat triangular in form. Posteriorly it is attached to the nasal and superior maxillary bones; and anteriorly it meets the one of the opposite side for a short distance above, but the two are separated below by an interval, in which the cartilage of the septum appears. Inferiorly the lateral cartilage is contiguous to the cartilage of the aperture, and is connected to it by fibrous tissue.

The *cartilage of the aperture* (fig. 3, ²) forms nearly a ring around the nostril. In front it is bent at an acute angle, and from this point a part extends backwards on both the outer and inner sides of that aperture. The *part* of the cartilage, which bounds the opening externally, does not reach downwards to the margin of the nostril, but ceases on a level with the groove on the outer aspect of the wing of the nose; it is narrow and pointed behind, but swells out in front and forms with its fellow the prominence of the

* Lateral cartilages of the nose (Arnold). 1. Upper lateral cartilage. 2. Lower lateral, or the cartilage of the aperture.

apex of the nose. The inner part projects backwards along the septum of the nose, nearly to the superior maxillary bone; it assists in the formation of the partition between the nostrils, and extends below the level of the septum nasi. The cartilage of the aperture has not any attachment directly to bone; but it is united above to the lateral cartilage by fibrous tissue, and is connected below with the dense structure that forms the margin of the aperture of the nostril. At the tip of the nose the cartilages of opposite sides touch.

another in-
side nostril.

Not inserted
into bone.

Behind the outer half of the cartilage of the aperture, in the dense tissue that fixes it to the bone; are two or three small pieces of cartilage—*cartilaginee minores vel sesamoideae*, which seem to result from the breaking up of the hinder extremity of the cartilage of the aperture.

Accessory
cartilages.

The APPENDAGES OF THE EYE consist of the eyebrow, the eyelid, and the lachrymal apparatus. Some of these can be seen now on the opposite side of the face; but the apparatus for the tears will be dissected after the orbit has been completed.

Appendages
of the eye.

The *eyebrow* (*supercilium*) is a curved eminence just above the eye, which is placed over the orbital arch of the frontal bone. It consists of thickened integuments, and its prominence is also due to the subjacent orbicularis palpebrarum. It is furnished with long coarse hairs, that are directed outwards, and towards one another.

Eyebrow.

The *eyelids* are two semilunar folds in front of the eye, which are freely moveable, and can be approached over the eyeball, or can be separated so as partly to lay it bare. The upper lid is the largest and the more moveable of the two, and descends below the middle of the eyeball when the two meet; it is also provided with a special muscle to raise it. The interval between the open lids is named *fissura palpebrarum*. Externally and internally they are united by a commissure or *canthus*.

Eyelids.

Upper
largest.

The free margin is thicker than the rest of the lid, and is semilunar in form for the greater part (fig. 7); but towards the inner side, or about a quarter of an inch from the commissure, it becomes straight. At the spot where these differently shaped parts join is a small white eminence, the *papilla lachrymalis*, in which is the *punctum lachrymale* or the opening of the canal for the tears. This margin is provided anteriorly with the eyelashes, and posteriorly with the openings of the Meibomian glands: but both the

Shape of
margin.

Papilla
lachrymalis.

Punctum.

Where hairs
and aper-
tures.

cilia and the Meibomian glands are absent from the part of the lid which is internal to the opening of the lachrymal canal.

Eyelashes.

The *eyelashes* (cilia) are two or more rows of long hairs, which are fixed into the anterior edge of the free border of the lid; they are largest in the upper lid, and diminish in length from the centre towards the sides. The cilia are so arranged as to be convex towards one another.

Different parts in eyelids.

STRUCTURE OF THE EYELIDS.—Each lid consists fundamentally of a piece of cartilage attached to the bones by ligaments. Superficial to this framework is the integument, with a layer of fibres of the orbicularis palpebrarum, and beneath it a mucous lining of the conjunctiva. The upper lid has also in it the tendon of the levator palpebræ. Vessels and nerves are furnished to these parts.

Examine structure of lids.

Dissection.—The student may continue with the structure of the lids on the left side, on which the muscles are dissected. Let the bit of tow or wool remain beneath the lids, and let the palpebral part of the orbicularis palpebrarum be thrown inwards by means of an incision around the margin of the orbit. In raising the muscle, care must be taken of the palpebral ligament, and of the vessels and nerves of the lid.

Layer of orbicularis.

Orbicularis palpebrarum.—The palpebral fibres of this muscle form the thin pale layer that occupies the eyelids. A thin stratum of areolar tissue without fat unites the muscle with the skin.

A fibrous layer.

The *palpebral ligament* is a stratum of fibrous membrane, which is continued from the margin of the orbit to join the free edge of each tarsal cartilage. At the inner part of the orbit the ligament is thin and loose, but at the outer part it is much thicker and stronger.

Cartilage forms part of the lid.

The *tarsal cartilages*, one for each eyelid, give the form and strength to the lids, and are formed of yellow or spongy cartilage. Each is fixed internally by the *ligamentum vel tendo palpebrarum*, and externally by a fibrous band—*external tarsal ligament*, to the outer part of the orbit. The margin corresponding with the edge of the lid is free, and thicker than the rest of the cartilage. On the inner surface each cartilage is lined by the mucous membrane or conjunctiva.

Difference in the two lids.

The cartilages are not alike in the two lids. In the upper eyelid, where the cartilage is largest, it is crescentic in shape, and is about half an inch wide in the centre; and to its fore part the tendon of the levator palpebræ is

the cartilage to another, are very delicate, and in some bodies are not to be found. Five small muscles are usually described, which receive their names for the most part from the several eminences of the external ear.

Dissection.—In seeking the following small muscles, let the integument be removed only over the spot where each muscle is said to be placed. A sharp knife and a good light are necessary for the display of the muscular fibres. Frequently the dissector will not find one or more of the set described below.

The *muscle of the tragus* (fig. 4, ³) is always found on the external aspect of the process from which it takes its

muscles of
external ear.

How to find
the small
muscles.

One muscle
on tragus.

Fig. 4.*



Fig. 5.†



name. The fibres are short, nearly transverse, and extend from the outer to the inner part of the tragus.

The *muscle of the antitragus* (fig. 4, ⁴) is the best marked of all. It arises from the outer part of the antitragus, and the fibres are directed upwards to be inserted into the pointed extremity of the antihelix.

One to
antitragus.

The *small muscle of the helix* (fig. 4, ¹) is often indistinct or absent. It is placed on the part of the rim of the ear that extends into the concha.

One on root
of helix.

The *large muscle of the helix* (fig. 4, ²) arises above the small muscle of the same part, and is inserted into the front of the helix, where this is about to curve backwards. It is usually present.

Another
higher on
helix.

* Muscles on the front of the ear. 1. Small muscle of the helix. 2. Large muscle of the helix. 3. Muscle of the tragus. 4. Muscle of the antitragus.

† Back of the cartilage of the ear. 5. Transverse muscle. 6. Oblique muscle (Tod) sometimes seen.

- And one muscle at back of concha. The *transverse muscle of the auricle* (fig. 5, ^a) is found at the back of the ear, in the depression between the antihelix and the convexity of the surface. It arises from the convexity of the cartilage that forms the concha, and is inserted into the back of the antihelix. The muscle is mixed with much fibrous tissue, but it is well seen when this is removed.
- Clean the cartilage. *Dissection.*—The pinna may now be detached by cutting it as close as possible to the bone. When the integuments are entirely taken off, the cartilage of the pinna will be apparent; but in removing the integuments, the lobule of the ear, which consists only of skin and fat, will disappear.
- Cartilage forms only part of external ear. The *cartilage of the pinna* resembles much the external ear in form, and presents for notice nearly the same parts. The rim of the helix, however, subsides posteriorly in the antihelix about the middle of the pinna; whilst anteriorly
- Deficient inferiorly a small piece projects from it, and a fissure will be found near that projection. The antihelix is divided posteriorly into two pieces; one of these is pointed, and is joined by the helix, the other is continued into the antitragus. Inferiorly the cartilage is fixed to the margin of the external auditory aperture in the temporal bone, and forms the outer part of the meatus auditorius, but it does not give rise to a complete tube, for the upper and posterior part of that canal is closed by fibrous tissue. On the posterior aspect of the concha is a strong vertical process of cartilage.
- and at upper part of meatus. In the piece of cartilage that forms the under part of the meatus are two *fissures* (Santorini), one is at the base of the tragus, the other passes from before backwards.
- Its fissures. *Ligaments* connect the pinna with the head, but others pass from one point of the cartilage to another.
- Ligaments: external; The external ligaments are the condensed bands of fibrous tissue that extend between the same points as the external muscles (p. 2), though commonly only an anterior and
- special. posterior are described. The chief special ligament crosses the interval between the tragus and the beginning of the helix, and completes the tube of the meatus.
- Outline of facial nerve. The *FACIAL NERVE* (portio dura) is a part of the seventh cranial nerve, and confers motor power on the muscles of the face. Numerous communications take place between it and the fifth nerve, and the chief of these are found above and below the orbit, and over the side of the lower jaw.
- Dissection of nerve. *Dissection.*—The facial nerve is to be displayed on the right side of the face if there is time sufficient before the

body is turned (see p. 1). Some of the nerve is concealed by the parotid gland, but the greater part is anterior to the glandular mass.

To expose the ramifications beyond the parotid gland, let the skin be raised from the face in the same manner as on the left side. The different branches of the nerve are then to be sought as they escape from beneath the anterior border of the gland, and to be followed forwards to their termination. The highest branches that go to the temple have been already partly dissected above the zygoma; and their junction with the temporal branch of the superior maxillary, and with the supra-orbital nerve has been seen. Other still smaller branches are to be traced to the outer part of the orbit, where they enter the eyelids and communicate with the other nerves in the lids; and by means of this set, whilst it crosses the malar bone, a junction is formed with the subcutaneous malar nerve of the fifth. With the duct of the parotid are two or more large branches, which are to be followed below the orbit to their junction with the infra-orbital, nasal, and infra-trochlear nerves. The remaining branches to the lower part of the face are smaller in size: one joins with the buccal nerve at the lower part of the buccinator muscle; and one or two others are to be traced forwards to the lower lip and to the labial branch of the inferior dental nerve.

In order to trace backwards the trunk of the nerve through the gland, the integuments should be taken from the surface of the parotid as on the other side, and the gland removed piece by piece. In this proceeding the small branches of communication of the great auricular nerve with offsets of the facial, and the branches that dip down from the facial to the auriculo-temporal nerve are to be sought. Lastly, the tip of the mastoid process may be cut off with a chisel; and after turning it backwards with the sterno-mastoid muscle adhering to it, the small branches of the facial nerve to the back of the ear, and to the digastric and stylo-hyoid muscles, are to be looked for close to the base of the skull.

THE NERVE OUTSIDE THE SKULL.—The nerve issues from the stylo-mastoid foramen, after traversing the aqueduct of Fallopius, and furnishes immediately the three following small branches:—

a. The *posterior auricular branch* turns upwards in front of the mastoid process, where it communicates with the great auricular, and with a branch to the ear from the pneumo-

beyond
parotid,

and of the
nerve in the
parotid.

Branches
outside the
skull.

Posterior
auricular
branch.

gastric (eighth) nerve, and ends in auricular and mastoid offsets (p. 8).

Branch to digastric.

b. The branch to the digastric muscle generally arises in common with the next. It is distributed by many offsets to the posterior belly of the muscle near the origin. Sometimes one of these offsets passes through the fleshy fibres, and descends to join the glosso-pharyngeal nerve.

Branch to stylo-hyoideus.

c. The branch to the stylo-hyoideus is a long slender nerve, which is directed inwards to its muscle, and enters it about the middle. This branch communicates with the sympathetic nerve on the external carotid artery.

As soon as the facial nerve has given off those branches, it is directed forwards through the gland, and divides near the ramus of the jaw into two large trunks—temporo-facial and cervico-facial.

The upper part of the trunk

The TEMPORO-FACIAL TRUNK furnishes offsets to the side of the head and face, whose ramifications extend as low as the meatus auditorius. As this trunk crosses over the external carotid artery, it sends downwards branches to join the auriculo-temporal portion of the inferior maxillary nerve; and in front of the ear it gives some filaments to the tragus of the pinna. Three sets of branches, temporal, malar, and infra-orbital, are derived from the ending of the temporo-facial nerve.

has three sets of branches.

Temporal branches pass to side of head.

The temporal branches ascend obliquely over the zygoma to the orbicular muscle, the corrugator supercili, and the anterior part of the occipito-frontalis; in which they are united with offsets of the supra-orbital nerve. The *attrahens aurem* muscle is supplied by this set; and a junction takes place above the zygoma with the temporal branch of the superior maxillary nerve.

Malar branches go to eyelids.

The malar branches are directed to the outer angle of the orbit, and are distributed to the orbicularis muscle and the eyelids. In the eyelids communications take place with the palpebral filaments of the fifth nerve (p. 36); and near the outer part of the orbit, with the small subcutaneous malar branch of the superior maxillary nerve.

Branches are lost between eye and mouth.

The infra-orbital branches are larger than the rest, and are furnished to the muscles and the integument between the eye and mouth. Close to the orbit, and beneath the elevator of the upper lip, a remarkable communication,—*infra-orbital plexus*, is formed between these nerves and the infra-orbital branches of the superior maxillary. After crossing the branches of the fifth nerve, some small offsets of the facial nerve pass inwards to the side of the nose, and



DISSECTION OF THE ORBIT.

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others upwards to the inner angle of the orbit, to join the nasal and infra-trochlear branches of the ophthalmic nerve.

The CERVICO-FACIAL is smaller than the other trunk, and supplies nerves to the lower part of the face and to the upper part of the neck. Its highest branches join the lowest offsets of the temporo-facial nerve, and thus complete the network on the face. This trunk, whilst in the parotid, gives twigs to the gland, and is united with the great auricular nerve. The terminal branches distributed from it are, buccal, supra-maxillary, and infra-maxillary.

Lower part of the trunk also gives three sets of branches.

The buccal branches pass forwards to the angle of the mouth, supplying the buccinator muscle, and they terminate in the orbicularis oris. On the buccinator they join the branch of the inferior maxillary nerve to that muscle.

Buccal branches to corner of mouth.

The supra-maxillary branches course inwards above the base of the lower jaw to the middle line of the chin, and supply the muscles and the integument between the chin and mouth. Beneath the depressor anguli oris the branches of the facial join offsets of the labial branch of the inferior dental nerve, in the same manner as the junction is made below the orbit; and the branches of the facial cross those of the fifth nerve in their course onwards to the middle line.

Supra-maxillary between mouth and chin.

The infra-maxillary branches are placed below the jaw, and are distributed to the upper part of the neck. The anatomy of these nerves will be given with the dissection of the anterior triangle of the neck (p. 62).

Infra-maxillary to neck.

SECTION IV.

DISSECTION OF THE ORBIT.

Directions.—The orbit should be dissected on that side on which the muscles of the face have been seen.

Position.—In the examination of the orbit the head is placed in the same position as in the dissection of the sinuses of the base of the skull.

Position of the body.

Dissection.—For the display of the contents of the orbit, it will be necessary to take away the bones forming the roof of the space in the following manner:—Two cuts should be made with a saw through the margin of the orbit, one being placed at the outer, the other near the inner angle of the cavity; and these should be continued backwards with a chisel, along the roof of the orbit, nearly to the optic foramen. The piece of bone included in the incisions may

How to open the orbit.

gastric (eighth) nerve, offsets (p. 8).

Branch to digastric.

b. The *branch to the* common with the next to the posterior belly of times one of these offsets and descends to join the

Branch to stylo-hyoides.

c. The *branch to the* which is directed inward the middle. This branchetic nerve on the external

As soon as the facial it is directed forwards the ramus of the jaw in and cervico-facial.

The upper part of the trunk

The *TEMPORO-FACIAL* of the head and face, with the meatus auditorius, external carotid artery, the auriculo-temporal plexus and in front of the ear of the pinna. Three sets of infra-orbital, are derived from the facial nerve.

has three sets of branches.

Temporal branches pass to side of head.

The *temporal branches* to the orbicular muscle anterior part of the occipital united with offsets of the *aurem* muscle is supplied in place above the zygomatic superior maxillary nerve

Malar branches go to eyelids.

The *malar branches* to orbit, and are distributed to eyelids. In the eyelids the palpebral filaments the outer part of the malar branch of the superior

Branches are lost between eye and mouth.

The *infra-orbital branches* are furnished to the mouth the eye and mouth. The *elevator* of the upper lip *infra-orbital plexus*, is formed by the infra-orbital branches crossing the branches of the facial nerve pass

numerous, viz. the second, third, fourth, ophthalmic of the fifth, and the sixth nerve, together with the small orbital branch of the superior maxillary nerve; and their general distribution is as follows:—The second nerve enters the eyeball, the third is furnished to all the muscles of the cavity but two, the fourth enters the superior oblique (one of the two excepted), and the sixth is spent in the external rectus muscle. The fifth nerve supplies some filaments to the eyeball, but the greater number of its branches pass through the orbital cavity to the face. The ophthalmic vessels are contained likewise in the orbit.

their distribution;

and some vessels.

The *lacrimal gland* secretes the tears, and is situate in the hollow on the inner side of the external angular process of the frontal bone. It is of a lengthened form, something like an almond; and from its anterior part a thin piece projects beneath the upper eyelid. The upper surface is convex, and in contact with the periosteum, to which it is connected by fibrous bands that constitute a ligament for the gland; the lower surface rests on the eyeball and the external rectus muscle.

Lacrimal gland is at the outer part of the orbit.

In *structure* the lacrimal resembles the salivary glands; and its ducts, from six to eight in number, open by as many apertures in a semicircular line on the inner surface of the upper eyelid, near the outer canthus.

Its ducts open on upper eyelid.

The **FOURTH NERVE** (fig. 6, ⁴) is the most internal of the three nerves that enter the orbit above the muscles. After reaching this space, it is directed inwards to the superior oblique muscle, which it enters at the orbital surface, contrary to the general mode of distribution of the nerves on the ocular surface of the muscles.

Fig. 6.*



Fourth nerve

supplies superior oblique.

* Superficial view of the orbit, with the nerves entering above the muscles (Arnold). 1. The fifth nerve. 2. Ophthalmic nerve. 3. Third nerve. 4. Fourth nerve. 5. Optic nerve. 6. Sixth nerve. a. Internal carotid artery cut across.

- Ophthalmic nerve gives three branches. The OPHTHALMIC NERVE of the fifth (fig. 6, ², p. 19) as it approaches the sphenoidal fissure, furnishes from its inner side the nasal branch, and then terminates by dividing into the frontal and lachrymal branches; the former enters the orbit between the heads of the external rectus, but the other two lie, as before said, above the muscles.
- Frontal branch supplies the following. 1. The *frontal nerve* (fig. 6) is close to the outer side of the fourth as it enters the orbit, and is much larger than the lachrymal branch. In its course to the forehead the nerve lies along the middle of the orbit, and bifurcates anteriorly into the supra-trochlear and supra-orbital branches:—
- Branch above the pulley of oblique muscle; sometimes two: a. The *supra-trochlear branch*, which is of small size, passes inwards towards the pulley of the superior oblique muscle, where it leaves the orbit to end in the eyelid and forehead (p. 7.) Before the nerve turns round the margin of the frontal bone, it sends downwards a branch of communication to the infra-trochlear branch of the nasal nerve. Frequently there are two supra-trochlear branches; in such instances one arises near the back of the orbit.
- and branch through orbital notch. b. The *supra-orbital branch* is the continuation of the frontal nerve in direction and size, and leaves the orbit by the supra-orbital notch. It then ascends on the forehead, and supplies the external part of the head (p. 7). Whilst in the notch the nerve gives downwards palpebral filaments to the upper lid.
- Lachrymal nerve 2. The *lachrymal nerve* (fig. 6), after entering the orbit in a separate tube of the dura mater, is directed forwards in the outer part of the cavity, and beneath the lachrymal gland to the upper eyelid, where it pierces the palpebral ligament, and is distributed to the structures of the lid.
- ends in eyelid; Branches.—The nerve furnishes branches to the lachrymal gland; and near the gland it sends downwards one or two small filaments to communicate with the orbital branch of the superior maxillary nerve. Occasionally this nerve has a communicating filament with the fourth nerve.
- its offsets join superior maxillary. 3. The *nasal nerve* is not visible at this stage of the dissection: it will be noticed afterwards at p. 46.
- Dissection. Dissection.—Divide the frontal nerve about its middle, and throw the ends forwards and backwards: by raising the posterior part of the nerve, the distinct origin of the nasal branch from the ophthalmic trunk will be seen. The lachrymal nerve may remain uncut.
- Elevator of upper eyelid The LEVATOR PALPEBRÆ SUPERIORIS is the most superficial muscle, and is attached posteriorly to the roof of the orbit in front of the optic foramen. The muscle widens as it ex-

tends forwards, and bends downwards in front of the eyeball, to be *inserted* by a wide tendon into the fore part of the tarsal cartilage. By one surface the muscle is in contact with the frontal nerve and the periosteum; and by the other, with the superior rectus muscle. If it is cut across about the centre, a small branch of the third nerve will be seen entering the under surface of the posterior half.

is attached to tarsal cartilage;
is highest muscle in orbit.

The RECTUS SUPERIOR is the upper of four muscles that lie around the globe of the eye. It *arises* from the upper part of the optic foramen, and is connected with the other recti muscles around the optic nerve. Near the front of the eye the fleshy fibres end in a tendon, which is *inserted*, like the other recti, into the sclerotic coat behind the union of this with the cornea. The under surface of the muscle is in contact with the globe of the eye, and some vessels and nerves to be afterwards seen; the other surface is covered by the preceding muscle.

Upper rectus muscle.
Origin.
Insertion.
Position to other parts.

The SUPERIOR OBLIQUE MUSCLE is thin and narrow, and passes through a fibrous loop at the inner angle of the orbit, before reaching the eyeball. The muscle *arises* from the inner part of the optic foramen, and ends anteriorly in a rounded tendon, which, after passing through the loop before referred to, is reflected backwards and outwards between the superior rectus and the globe of the eye, and is *inserted* into the sclerotic coat behind the middle of the eyeball. The fourth nerve is supplied to the orbital surface of the muscle, and the nasal nerve lies below it. The thin insertion of the muscle lies between the superior and the external rectus, and near the tendon of the inferior oblique.

Upper oblique muscle
enters a loop.
Insertion.
Connections.

The *loop*, or *pulley*, or *trochlea*, is a fibro-cartilaginous ring about two lines and a half in length, which is attached by fibrous tissue to the depression of the frontal bone at the inner angle of the orbit. A fibrous prolongation is continued from the anterior margin of the pulley on the tendon as far as the eyeball; and a synovial membrane lines the ring, to facilitate the movement of the tendon through it. To see the synovial membrane and the tendon, this prolongation must be cut away.

Pulley of the muscle.

Dissection.—The superior rectus muscle is next to be divided about the middle and turned backwards, when a branch of the third nerve to its under surface will be found. The nasal nerve and the ophthalmic artery and vein will be now seen crossing inwards above the optic nerve: these should be traced forwards to the inner angle, and backwards to the posterior part of the orbit. By taking away some of

Dissection.

- To find lenticular ganglion. the fat between the optic nerve and the external rectus, at the back of the orbit, the small lenticular ganglion and its branches will be discovered : the student will find the ciliary branches, that lie along the side of the optic nerve, the best guide to the situation of the ganglion. The dissector should find then the branches from the nasal and third nerves to the ganglion. And, lastly, he should separate from one another the nasal, third, and sixth nerves, as they enter the orbit between the heads of the external rectus muscle.
- Third nerve. The THIRD NERVE is placed highest in the wall of the cavernous sinus ; but at the sphenoidal fissure it descends below the fourth, and two branches (frontal and lachrymal) of the ophthalmic nerve. The nerve enters the orbit between the heads of the outer rectus, having previously divided into two parts.
- as it enters orbit.
- Its upper branch. a. The *upper piece*, the smallest in size, ends in the under surface of the levator palpebræ and superior rectus muscles.
- Lower branch. b. The *lower part* supplies some of the other muscles, and will be dissected afterwards (p. 49).
- Nasal nerve. The *nasal branch* of the ophthalmic nerve (fig. 6) enters the orbit between the heads of the rectus, and lies between the two parts of the third nerve. In the orbit the nerve is directed obliquely inwards, to reach the anterior of the two foramina in the inner wall. Passing through this aperture, the nerve appears in the cranium, at the outer margin of the cribriform plate of the ethmoid bone. Finally, it enters the nasal cavity by an aperture at the front of the cribriform plate : and after passing behind the nasal bone, it is directed outwards between that bone and the cartilage, to end on the outer side of the nose.
- General course to the face.
- In the orbit. In the *orbit*, the nasal lies at first over the optic nerve, but beneath the superior rectus and levator palpebræ muscles, and afterwards below the superior oblique ; in this part of its course it furnishes the following *branches* :—
- Branches.
- Long root of lenticular ganglion. a. The *branch to the lenticular ganglion* is about half an inch long and very slender, and arises as soon as the nerve enters the orbit : this is the long root of the lenticular ganglion.
- Long ciliary branches. b. *Long ciliary branches*.—As the nasal crosses the optic nerve, it supplies two or more ciliary branches to the eyeball. These lie on the inner side of the optic, and join the ciliary branches of the lenticular ganglion.
- Infra-trochlear branch. c. The *infra-trochlear branch* arises as the nasal nerve is about to leave the cavity, and is directed forwards below the pulley of the superior oblique muscle to the inner part of

the orbit, where it ends in the upper eyelid, the conjunctiva, and the side of the nose. Before this branch leaves the orbit it receives an offset of communication from the supra-trochlear nerve.

In the *nose*. Whilst in the nasal cavity the nerve furnishes branches to the lining membrane of both the septum narium and the outer wall; these will be subsequently referred to with the nose. Nasal nerve in the nose,

Termination of the nasal nerve.—After the nerve becomes cutaneous on the side of the nose, it descends beneath the compressor naris muscle, and ends in the integuments of the wing and tip of the nose. and on the face.

The OPHTHALMIC OR LENTICULAR GANGLION is a small roundish body, of the size of a pin's head, and of a reddish colour. It is placed at the back of the orbit between the optic nerve and the external rectus, and commonly on the outer side of the ophthalmic artery. By its posterior part the ganglion has branches of communication with other nerves (its roots); and from the anterior part proceed the ciliary nerves to the eyeball. In the ganglion, sensory, motory, and sympathetic filaments are combined. Lenticular ganglion. Situation. Connections.

The *offsets of communication* are three in number. One, the *long root*, is the branch of the nasal nerve before noticed, which joins the superior angle. A second branch of considerable thickness (*short root*) passes from the inferior angle to join the branch of the third nerve that supplies the inferior oblique muscle. And the third *root* is derived from the sympathetic (the cavernous plexus), either as a distinct branch to the posterior border of the ganglion or in union with the long root. Three roots: long, short, and sympathetic.

Branches.—The short *ciliary nerves* are ten or twelve in number, and are collected into two bundles, which leave the upper and lower parts (superior and inferior angles) of the ganglion. In the upper bundle are four or five, and in the lower, six or seven nerves. As they extend along the optic nerve to the eyeball they occupy the outer and under parts, and communicate with the long ciliary branches of the nasal nerve. Ciliary branches to eyeball.

The OPHTHALMIC ARTERY is a branch of the internal carotid, and enters the orbit through the optic foramen. At first the vessel is outside the nerve, but it then courses inwards, over or under the nerve, to the inner angle of the orbit, where it ends in terminal branches. Ophthalmic artery in the orbit.

The *branches* of the artery are numerous, though considerable in size, and may be arranged in three sets:—one Branches.

being outside the optic nerve, another above it, and a third set on its inner side.

Lachrymal
branch

supplies
gland.

Branch to
the retina.

Supra-orbi-
tal branch.

Ciliary
arteries are
posterior—

two named
long ciliary ;

and anterior
ciliary.

Muscular.

Ethmoidal
branches.

Posterior
and anterior.

Branches to
eyelids,

a. The *lachrymal branch* accompanies the nerve of the same name to the upper eyelid, where it ends by supplying that part, and anastomosing with the palpebral arches. It supplies branches, like the nerve, to the lachrymal gland and the conjunctiva ; and it anastomoses with the middle meningeal and deep temporal arteries, by offsets through the sphenoidal fissure and the outer wall of the orbit.

b. The *central artery of the retina* is a very small branch that enters the optic nerve, and so reaches its destination in the eyeball.

c. The *supra-orbital branch* arises beneath the levator palpebræ and superior rectus muscles ; it then takes the course of the nerve of the same name through the notch in the margin of the orbit, and ends in branches on the forehead (p. 7). As it winds round the margin of the orbit it supplies the eyelid and the orbicularis muscle.

d. The *ciliary branches* are uncertain in their place of origin, and enter the eyeball at both the front and back. The *posterior ciliary* are furnished from the ophthalmic trunk, or some of its branches. About twelve in number, they are continued to the eyeball around the optic nerve, and perforate the sclerotic coat at the posterior part. Two of this set (one on each side of the optic nerve) are named *long ciliary* ; they pierce the sclerotic farther out than the others, and are placed then along the middle of the eyeball. The *anterior ciliary* arteries arise from muscular branches of the ophthalmic, and pierce the sclerotic coat near the cornea : in the eyeball they anastomose with the posterior ciliary. See the dissection of the eyeball for the ending of these vessels.

e. The *muscular branches* are furnished from the artery in its course, and those to the lower muscles often arise together.

f. The *ethmoidal branches* are two, anterior and posterior, which pass through the two foramina in the inner wall of the orbit. The *posterior* is the smaller of the two, and furnishes small meningeal offsets (anterior) to the dura mater of the base of the skull. The *anterior* branch accompanies the nasal nerve, and gives likewise small meningeal offsets to the dura mater. Both send branches to the nose through the apertures in the cribriform plate of the ethmoid bone.

g. The *palpebral branches*, one for each eyelid, generally

arise together opposite the pulley of the superior oblique muscle, and then separate from one another. The arches they form have been dissected with the eyelids (p. 35).

h. The *nasal* is one of the last branches of the ophthalmic, and is distributed to the side of the nose, on which it anastomoses with the nasal and angular branches of the facial artery. Nasal branch.

i. The *frontal branch* turns round the margin of the orbit, and is distributed on the forehead (p. 5). Frontal branch.

The *ophthalmic vein* corresponds in its course and most of its branches with the artery of the same name. It begins at the inner angle of the orbit, where it joins the facial vein, and receives tributary branches in its progress to the back of the cavity. Posteriorly it leaves the artery, and escapes from the orbit by the sphenoidal fissure, between the heads of the external rectus. It ends in the cavernous sinus. Ophthalmic vein
ends in cavernous sinus.

The *OPTIC NERVE* can be now seen to extend from the optic foramen to the back of the eyeball. As the nerve enters the foramen, it is surrounded by the recti muscles; and beyond that spot, as far as the eyeball, the ciliary arteries and nerves entwine around it. It terminates in the retinal expansion of the eye. Optic nerve
ends in retina.

Dissection.—Take away the ophthalmic artery, and divide the optic nerve about its middle, together with the small ciliary vessels and nerves. Turn forwards the eyeball, and fasten it in that position with hooks. On removing some fat, the three recti muscles—inner, outer, and inferior, and the lower branch of the third nerve will appear. Dissection.

The *lower branch of the third nerve* supplies three muscles in the orbit. Whilst entering this space between the heads of the external rectus, it lies below the nasal, and rather above the sixth nerve. Almost immediately afterwards the nerve divides into three branches. One of these enters the internal rectus; another the inferior rectus; and the third, the longest and most external branch, is continued forwards to the inferior oblique muscle which it enters at the hinder border. Soon after its origin the last nerve communicates with the lenticular ganglion, forming the short root of that body, and furnishes two or more filaments to the inferior rectus. Lower branch of third nerve is muscular, and joins lenticular ganglion.

The *SIXTH NERVE* enters the orbit between the heads of the external rectus, below the other nerves in that interval, and above the ophthalmic vein. In the orbit it is distributed to the external rectus muscle. Sixth nerve enters external rectus.

RECTI MUSCLES.—The *internal, inferior, and external* Straight

- muscles of eyeball. Origin. *rectus* muscles are placed with reference to the eyeball as their names express. They *arise* posteriorly from the circumference of the optic foramen by a common attachment, which partly surrounds the optic nerve. But the external rectus differs from the others in having two heads; an upper which joins the superior rectus; and a lower and larger one that blends with the inferior rectus, and is attached to a bony point on the lower border of the sphenoidal fissure, near to the inner end: some muscular fibres are also connected with a tendinous band between the heads. The muscles are directed forwards, and have a tendinous *insertion* into the ball of the eye, about a quarter of an inch from the cornea. Between the heads of origin of the external rectus, the different nerves before mentioned enter the orbit, viz. the third, the nasal branch of the fifth, and the sixth, together with the ophthalmic vein.
- Insertion. *Dissection.*—By opening the optic foramen, the attachment of the recti muscles will be more fully seen. To dissect out the inferior oblique muscle, let the eyeball be replaced in its natural position; then by taking away the conjunctival lining of the lower eyelid near the inner part of the orbit, and removing some fat, the muscle will appear beneath the eyeball, bending from the inner to the outer side.
- Lower oblique muscle. The INFERIOR OBLIQUE MUSCLE is situate near the anterior margin of the orbit, and differs from the other muscles in the circumstance of its course being directed across, instead of parallel to the axis of the orbit. It *arises* from the superior maxillary bone, between the margin of the orbit and the groove for the lachrymal sac. From this spot the muscle passes outwards beneath the inferior rectus, and between the eyeball and the external rectus, to be *inserted* into the sclerotic coat between the last muscle and the superior rectus. The borders of the muscle look forwards and backwards, and the posterior receives the branch of the third nerve. The tendon of insertion is near that of the superior oblique muscle, but rather closer to the optic nerve.
- Origin. *Dissection.*—To expose the small tensor tarsi muscle, the palpebral ligament attaching the eyelids to the margin of the orbit must be cut through, where this has not been done; but the lids must be left connected at the inner commissure by means of the tendo palpebrarum. By looking to the posterior aspect of the tendinous band attaching the tarsal cartilages, after the lids have been placed across the nose, the pale fibres of the tensor tarsi will be seen.
- Course. *Dissection.*—To expose the small tensor tarsi muscle, the palpebral ligament attaching the eyelids to the margin of the orbit must be cut through, where this has not been done; but the lids must be left connected at the inner commissure by means of the tendo palpebrarum. By looking to the posterior aspect of the tendinous band attaching the tarsal cartilages, after the lids have been placed across the nose, the pale fibres of the tensor tarsi will be seen.
- Insertion. *Dissection.*—To expose the small tensor tarsi muscle, the palpebral ligament attaching the eyelids to the margin of the orbit must be cut through, where this has not been done; but the lids must be left connected at the inner commissure by means of the tendo palpebrarum. By looking to the posterior aspect of the tendinous band attaching the tarsal cartilages, after the lids have been placed across the nose, the pale fibres of the tensor tarsi will be seen.
- Connections. *Dissection.*—To expose the small tensor tarsi muscle, the palpebral ligament attaching the eyelids to the margin of the orbit must be cut through, where this has not been done; but the lids must be left connected at the inner commissure by means of the tendo palpebrarum. By looking to the posterior aspect of the tendinous band attaching the tarsal cartilages, after the lids have been placed across the nose, the pale fibres of the tensor tarsi will be seen.
- Seek tensor tarsi. *Dissection.*—To expose the small tensor tarsi muscle, the palpebral ligament attaching the eyelids to the margin of the orbit must be cut through, where this has not been done; but the lids must be left connected at the inner commissure by means of the tendo palpebrarum. By looking to the posterior aspect of the tendinous band attaching the tarsal cartilages, after the lids have been placed across the nose, the pale fibres of the tensor tarsi will be seen.

The **TENSOR Tarsi muscle** arises from the ridge on the os unguis, and slightly from the bone behind the ridge. Its fibres are pale, and form a very small flat band, behind the ligamentum palpebrarum, which divides like that structure into a slip for each eyelid. In each eyelid the slip lies on the lachrymal canal, and blends with the other muscular fibres at the free margin of the tarsal cartilage.

Tensor tarsi muscle.

Insertion.

Dissection.—A small nerve, the orbital branch of the superior maxillary trunk, lies in some loose fat along the outer angle of the floor of the orbit, and may be brought into view by the removal of the eyeball and its muscles. This nerve is very soft and easily broken. Two branches, temporal and malar, are to be traced forwards from it : and a filament of the lachrymal nerve is to be followed to its junction with the former. The outer wall of the orbit may be cut away, bit by bit, to follow the temporal branch through to the surface of the head.

Trace offset of superior maxillary nerve.

The *orbital branch of the superior maxillary nerve* arises in the speno-maxillary fossa, and enters the orbit by the fissure of the same name. At the back of the orbit the nerve divides into malar and temporal branches, which ramify in the face and the side of the head.

Orbital branch of superior maxillary nerve ;

a. The *malar branch* (r. subcutaneus malaræ) is directed forwards along the floor of the orbit, and through a foramen in the malar bone to the face. After emerging from its foramen, this branch supplies the orbicularis, and communicates with the facial nerve.

its malar

b. The *temporal branch* ascends on the outer wall of the orbit, either beneath the periosteum, or in a groove in the bone ; and being joined by a filament from the lachrymal nerve, passes into the temporal fossa through a foramen in the malar bone. The nerve is then directed upwards between the temporal muscle and the bone, and perforates the temporal fascia near the orbit. Its distribution has been seen in the examination of the cutaneous nerves of the head (p. 7).

and temporal branches.

LACHRYMAL APPARATUS.—The lachrymal gland and ducts, with the puncta, canals, and sac, constitute the apparatus by which the tears are formed, and conveyed to the nose. The gland has been already described (see p. 43).

Apparatus for the tears.

Dissection.—Some bristles should be introduced into the lachrymal canals through the puncta of the eyelids that still remain in their natural place. The lachrymal sac will appear by removing the tensor tarsi and the areolar tissue from its surface, as it lies on the os unguis. The prolonga-

Dissection.

Apertures
in eyelids.

tion from the tendo palpebrarum over the sac should likewise be prepared.

The *puncta lachrymalia* are two small apertures, one for each lid, by which the tears enter the lachrymal canals. Each is situate in the free margin of the lid, about a quarter of an inch from the inner canthus, and in the elevation of the papilla lachrymalis.

Canals for
the tears.

The *lachrymal canals* (fig. 7, ¹) are two small tubes that come from the puncta, and convey the tears to the lachrymal sac; their situation is marked by the bristles that have been inserted in them. In their course inwards the canals lie along the tendo-palpebrarum, one above and the other below

Fig. 7.*



Difference
in the two
lids.

it, and they are somewhat arched with the concavity towards the tendon. Internally, they open near together into the lachrymal sac rather above its middle. The canal in the upper eyelid is longer and more arched than that in the lower lid.

Receptacle
of the tears.

The *lachrymal sac and duct* (fig. 7) extend from the inner part of the orbit to the nose, and convey the tears into the latter cavity. They form one tube, of which the upper dilated part is the sac, and the lower constricted end the duct.

Situation of
the sac, or
dilated part.

The *sac*, 2, is situate in the hollow formed by the os unguis and nasal process of the superior maxillary bone. Externally it is crossed by the ligament or tendon of the eyelids, and is covered by an expansion, derived from that tendon, which is fixed to the margins of the bony groove. If the aponeurotic covering be removed, the mucous membrane lining the interior will be seen. Into the outer side of the sac the lachrymal canals open.

Canal lead-

The *duct*, 3 (ductus ad nasum), is the narrowed part of the

* The eyelids and lachrymal apparatus. 1. Lachrymal canals. 2. Lachrymal sac. 3. Lachrymal duct. 4. Plica semilunaris. 5. Caruncula lachrymalis.

tube, that reaches to the nose. It is entirely encased by bone; and in length, size, and direction, it corresponds with the passage of the same name in the dried skull. In the nasal cavity it opens into the front of the inferior meatus, where its opening is guarded by a fold of the mucous membrane, but a bent probe introduced through the nostril may be readily passed into it from the meatus.

As the duct is continuous with the mucous membrane of the nose it has the same structure, viz. a fibrous external layer with a mucous lining. The epithelium of the sac and duct is ciliated as in the nose, but in the lachrymal canals it is scaly.

Directions.—The examination of the eyeball must be made on the fresh eye of either the ox or the sheep; but this part may be omitted with more advantage to the student till the dissection of the head and neck has been completed. The description of the eyeball will be found at the end of the book.

SECTION V.

DISSECTION OF THE NECK.

Position.—For the dissection of the right side of the neck let the head be supported at a moderate height, and let the face be turned to the left side, and fastened in that position with hooks. To obtain a good view of the neck, the right arm should be drawn under the body, so that the point of the shoulder may be depressed, and the parts put on the stretch.

Surface-marking.—The side of the neck presents a somewhat square outline, and is limited in the following way:—Inferiorly is the prominence of the clavicle, and superiorly is the base of the lower jaw with the skull. In front its boundary is marked by a line from the chin to the sternum, and behind by another line from the occiput to the acromial end of the clavicle. The part thus marked out is divided into two triangular spaces (anterior and posterior) by the diagonal position of the sterno-mastoid muscle. In consequence of the direction of that muscle the base of the anterior space is at the jaw, and the apex at the sternum; whilst the base of the posterior one is at the clavicle, and the apex at the head. The surface in front of the sterno-mastoid is depressed at the upper part of the neck, near the

position of the carotid vessels ; and behind the muscle, near the clavicle, is another slight hollow which points to the situation of the subclavian artery.

Promi-
nences in
the middle
line of neck,

Along the middle line of the neck the following parts can be recognised through the skin :—About two inches and a half from the base of the jaw is the eminence of the os hyoides, with its cornu extending laterally on each side. Below this may be felt the wide prominence of the thyroid cartilage, called *pomum Adami*, which is most marked in man ; and between the cartilage and the hyoid bone is a slight interval, corresponding with the thyro-hyoid membrane. Inferior to the thyroid, is the narrow prominent ring of the cricoid cartilage ; and between the two the finger may distinguish another interval, which is opposite the crico-thyroid membrane. From this spot to the sternum, and between the sterno-mastoid muscles, is a depression, whose depth is much increased in emaciated persons, in which the tube of the trachea can be felt. In some bodies, especially in women, the swelling of the thyroid gland may be perceived by the side of the upper part of the trachea.

and supra-
sternal de-
pression.

Direction.—As the time will not allow now the examination of the whole side of the neck, the student should lay bare in this stage only the parts behind the sterno-mastoid muscle.

Dissection of
the platys-
ma.

Dissection.—To raise the integuments from the posterior triangle of the neck, and from the structures immediately connected with it, the skin may be divided along the sterno-mastoid from the one end to the other, and afterwards along the clavicle as far as the acromion. The triangular flap of skin is to be reflected from before back towards the trapezius muscle. The superficial fascia, which will then be brought into view, contains the platysma ; and to see that muscle, it will be necessary to take the subcutaneous fat from its surface.

Platysma
muscle

arises at
shoulder ;

inserted into
jaw ;

covers
triangle.

The PLATYSMA MYOIDES is a thin subcutaneous muscular layer, which is now seen only in its lower half. The muscle is placed across the side of the neck, and extends from the top of the shoulder to the face. Its fibres take *origin* by fibrous bands from the clavicle and the acromion, and below these bones from the fascia covering the pectoral and deltoid muscles ; and then ascend over the side of the neck, to be *inserted* into the jaw. The lower part of the muscle is more closely united to the skin than the upper, and covers the external jugular vein as well as the lower part of the posterior triangle. At first the fibres of the

muscle are thin and scattered, but they increase in strength as they ascend. The oblique direction of the fibres should be noted, because in venesection in the external jugular vein the incision is to be so made as to divide them across.

Dissection.—The platysma is now to be cut across near the clavicle, and to be reflected upwards as far as the incision over the sterno-mastoid muscle, but it is there to be left attached. In raising the muscle the student must be careful of the deep fascia of the neck; and should dissect out the external jugular vein, and the superficial descending branches of the cervical plexus, which are close beneath the platysma.

The *external jugular vein* (fig. 8, ⁸) commences in the parotid gland (p. 31), and is directed backwards beneath the platysma to the lower part of the neck, where it pierces the deep cervical fascia to open into the subclavian vein. Its course down the neck will be marked by a line from the angle of the jaw to the middle of the clavicle. Beyond the sterno-mastoid muscle the vein is dilated, and the swollen part (sinus) is limited by two pair of valves, one below at the mouth of the vein, and the other near the muscle. The part of the vein now seen is joined by small superficial branches, and an offset connects it with the anterior jugular vein. Its size, and the height at which it crosses the sterno-mastoid muscle, are very uncertain.

The *deep cervical fascia* consists, like the aponeuroses in other regions of the body, of a superficial layer which surrounds the neck continuously, and of processes that are prolonged inwards between the muscles. In some bodies this fascia is thin and indistinct. In its extent round the neck the membrane incases the sterno-mastoideus, and presents a different disposition before and behind that muscle. As now seen passing backwards from the muscle, the fascia continues over the posterior triangular space, and then encloses the trapezius in its progress to the spines of the vertebræ. At the lower part of the neck the fascia is attached to the clavicle, and is perforated by the external jugular vein, and the cutaneous nerves. After the superficial layer has been removed near the clavicle, a deep process may be observed to surround the small omo-hyoid muscle, and to extend under the clavicle, where it is fixed to the back of that bone, and to the inner end of the first rib.

Dissection.—By the removal of the cervical fascia and the fat from the space between the sterno-mastoid and trapezius muscles, the posterior triangle of the neck will come into

Dissection.

External
jugular veincrosses side
of neck to
subclavian.Cervical
fascia.Part behind
sterno-mas-
toid musclesends a pro-
cess around
omo-hyoid.Dissection
of triangular
space.

view. Crossing the space obliquely about an inch above the clavicle, and thus dividing it into two, is the small omo-hyoid muscle.

Nerves
above omo-
hyoid;

Above the omo-hyoid muscle will be found the ramifications of the branches of the cervical plexus, together with the spinal accessory nerve; the latter will be recognised by its piercing the sterno-mastoid muscle. The greater number of the branches of the cervical plexus descend to the shoulder, but the small occipital and great auricular nerves ascend to the head, whilst the superficial cervical branch is directed forwards over the sterno-mastoid muscle.

vessels
below,

Below the omo-hyoideus are the subclavian artery and the brachial plexus, which have a deep position. In this part also the following vessels and nerve are to be sought, viz. the supra-scapular vessels behind the clavicle; the transverse cervical vessels beneath the omo-hyoid muscle; and, lastly, the small branch of nerve to the subclavian muscle, which lies about the middle of the space between the clavicle and the omo-hyoideus.

in triangular
space.

POSTERIOR TRIANGULAR SPACE.

Posterior
triangular
space of
the neck.

This space (fig. 8), having the form and position before noted, is about eight inches in length, and contains the cervical and brachial plexuses; the portion of the subclavian artery on which a ligature is usually placed; together with other smaller vessels and some offsets of the nerves. It is

Boundaries.

bounded in front by the sterno-mastoid muscle, 1, and behind by the trapezius 2. Its base corresponds with the middle third of the clavicle, and its apex is at the skull. In the area of the space are several muscles, which are placed in the following order from above down, viz., splenius capitis, levator anguli scapulæ 6; and middle and posterior scalenus 5; and at the lower and outer angle, somewhat beneath the trapezius, is the upper part of the serratus magnus. Covering the space are the structures already examined, viz. the skin and superficial fascia, the platysma over the lower half or more, and the deep fascia. The small omo-hyoid muscle, 3, crosses the lower part of the space, so as to subdivide it into two,—a lower or clavicular, and an upper or occipital.

Is divided
by omo-
hyoideus.

Part near
clavicle.

The *clavicular part* is small in size and close to the clavicle, and contains the subclavian artery. It is triangular in form, with its base directed forwards; and is bounded in front by the sterno-mastoid, 1, above by the omo-hyoid muscle, 3,

POSTERIOR TRIANGULAR SPACE.

and below by the clavicle. This small space measures commonly about one inch and a half from before backwards, and somewhat less in front at its base.

Fig. 8.*



* The dissection of the posterior triangular space of the neck, but the dissection is not carried high enough to lay bare the splenius muscle. 1. Sterno-mastoideus. 2. Trapezius. 3. Posterior belly of the omohyoid muscle. 4. Anterior scalenus, with the phrenic nerve on it. 5. Middle scalenus muscle. 6. Elevator of the angle of the scapula. 7. Third part of the subclavian artery. 8. External jugular vein joining the subclavian below. 9. Nerves of the brachial plexus. 10. Spinal accessory nerve.—The cut is altered slightly from a plate in Blandin's Surgical Anatomy.

Vessels and
nerves in
this part,

and their
relative
position.

Variations
in the size
of the space ;

also in the
depth,
both natural
and artificial.

Departure
from the
ordinary
state of the
vessels.

Crossing the area of this part of the space, rather above the level of the clavicle, is the trunk of the subclavian artery, 7 (the third part), which issues from beneath the anterior scalenus muscle, and is directed over the first rib to the axilla. In the ordinary disposition of the vessel the companion subclavian vein is seldom seen, owing to its situation being lower down, beneath the clavicle. Above the artery are the large cords of the brachial plexus, 9, which accompany the vessel, and become closely applied to it beneath the clavicle. Behind the artery and the nerves is the middle scalenus muscle, 5. And below the vessel is the first rib. Along the clavicular side of the space, and rather beneath the clavicle, are the supra-scapular vessels ; and crossing the upper angle, at the meeting of the omohyoid and sterno-mastoid muscles, are the transverse cervical vessels. Entering the space from above is the external jugular vein, 8, which descends over or under the omohyoideus near the anterior part, and opens into the subclavian vein ; in this spot the vein receives the supra-scapular and transverse cervical branches, and sometimes a small vein, over the clavicle, from the cephalic vein of the arm.

The size of the clavicular part of the posterior triangular space is influenced by the extent of the attachment of the trapezius and sterno-mastoid muscles along the clavicle. In some bodies these muscles occupy nearly the whole length of the bone, leaving but a small interval between them ; and in others they meet, so as to cover the underlying vessels. The space may be further increased or diminished by the position of the omohyoideus in the neck ; for this muscle may lie close to the clavicle, being attached thereto, or it may be distant one inch and a half from that bone. In depth the space varies naturally ; and in a short thick neck with a prominent clavicle, the artery is farther from the surface than in the opposite condition of the parts. But the depth is altered much more by the position of the clavicle, according as the limb may be raised or depressed. And lastly, the artery in its usual position may be concealed entirely by forcing upwards the arm and shoulder, as the collar bone is then raised above the level of the omohyoid muscle.

The situation of the trunk of the subclavian artery may vary much, for it may be one inch and a half above the clavicle, or at any point intermediate between this and its usual level, just above the prominence of that bone. Further, its position to the anterior scalenus may be altered ;

and instead of the vessel being beneath, it may be in front of, or even between the fibres of that muscle. Commonly there is not any branch connected with the artery in this part of its course; but the posterior scapular branch (fig. 8) may take origin from it at different distances from the scalenus, or there may be more than one branch (Quain). The subclavian vein rises upwards not unfrequently as high as the artery, or it may even lie with the artery beneath the anterior scalenus in some rare instances. The position of the external jugular vein with regard to the subclavian artery is very uncertain, and the branches connected with its lower end may form a kind of plexus over the arterial trunk.

The *occipital part* of the posterior triangular space is of larger extent than the other. Its boundaries in front and behind are the sterno-mastoid and the trapezius, and it is separated from the clavicular portion by the omo-hyoid muscle. In it are contained chiefly the ramifications of the cervical plexus; and a chain of lymphatic glands lies along the sterno-mastoid muscle. Beneath the spinal nerves is the middle scalenus, and still farther behind are some muscles of the back before seen. The spinal accessory nerve, 10, is directed obliquely across this interval from the sterno-mastoid muscle, which it pierces, to the under surface of the trapezius; and a communication takes place between this cranial nerve and the spinal nerves in the triangular space.

SUPERFICIAL BRANCHES OF THE CERVICAL PLEXUS.—Behind the sterno-mastoid muscle appear some of the ramifications of the cervical nerves in the plexus of the same name, and superficial branches are furnished from these both upwards and downwards.

A. The **ASCENDING SET** (fig. 8) are three in number, viz. small occipital, great auricular, and superficial cervical.

1. The *small occipital branch* comes from the second cervical nerve, and is directed upwards to the head along the posterior border of the sterno-mastoid muscle. At first the nerve is beneath the fascia; but near the occiput it becomes cutaneous, and is distributed between the ear and the great occipital nerve (p. 8). Occasionally there is a second cutaneous nerve to the head.

2. The *great auricular nerve* is a branch of that part of the plexus which is formed by the second and third cervical nerves. Perforating the deep fascia at the posterior border of the sterno-mastoid muscle, the nerve is then directed

Part of
triangular
space near
the head

contains
nerves and
lymphatics;

also spinal
accessory
nerve.

Nerves of
the cervical
plexus

that ascend,
viz.

Small occi-
pital.

Great auri-
cular,

upwards beneath the platysma to the lobule of the ear, where it ends in the following branches :—

supplie
facial, *a.* The *facial branches* are sent forwards to the integument over the parotid, and a few slender filaments pass through the gland to join the facial nerve.

auricular, *b.* The *auricular branches* ascend to the external ear, and are chiefly distributed on its cranial aspect ; one or more reach the opposite surface by piercing the pinna. On the ear they communicate with the branches furnished from the facial and pneumogastric nerves.

and mastoid
branches. *c.* The *mastoid branch* is directed backwards to the integument between the ear and the mastoid process ; and it joins the posterior auricular branch of the facial nerve (p. 39).

Superficial
cervical
nerve. 3. The *superficial cervical nerve* springs from the same source as the preceding, and turns forwards round the sterno-mastoid muscle about the middle. Afterwards it pierces the fascia, and ramifies over the anterior triangular space beneath the platysma myoides (see p. 62). There may be more than one branch to represent this nerve.

Nerves that
descend are *B.* The DESCENDING SET of branches (fig. 8), (supra-clavicular) are derived from the third and fourth nerves of the plexus, and are directed towards the clavicle over the lower part of the posterior triangular space. Their number is somewhat uncertain, but usually there are about three on the clavicle.

sternal,
supra-clavi-
cular, and
acromial. The most internal branch (sternal) crosses the clavicle near its inner end ; the middle branch lies about the middle of that bone ; and the posterior (acromial) turns over the attachment of the trapezius to the acromion. All are distributed to the integuments of the chest and shoulder.

Lymphatic
glands of
neck. The *lymphatic glands* (glandulæ concatenatæ) lie along the sterno-mastoid muscle, and are continuous at the lower part of the neck with the glands in the cavity of the thorax. There is also a superficial chain along the external jugular vein.

Dissection. *Dissection.*—The dissection of the posterior triangle should be repeated on the left side of the neck, in order that the difference in the vessels may be observed. Afterwards the reflected parts are to be replaced and carefully fastened in their natural position with a few stitches, preservative fluid having been previously applied with strips of calico.

The back to
be examined
now. *Directions.*—It is supposed that the body will be now turned on its fore part for the dissection of the back.

During the period allotted for this position the student is to learn the posterior part of the neck. After the completion of the dissection of the back the student should take out the spinal cord, and then return to the examination of the front of the neck. The head and neck may be detached from the trunk, supposing the thorax to be finished, by dividing the spinal column between the second and third dorsal vertebræ. By this step the student obtains the clavicles and the first ribs, and preserves the natural position of the parts at the root of the neck : he should moreover be careful to take the arch of the aorta with its branches.

Then detach
the head.

FRONT OF THE NECK.

Directions.—When the body has been turned again, the dissector should continue with the remainder of the right side of the neck, but if the facial nerve has been before omitted, he should dissect first that nerve.

Examine
right side of
neck.

Position.—After the part has been detached, the face is to be turned from the dissector, and a small narrow block is to be placed beneath the neck. Further, the neck is to be made tense by means of hooks, the chin being well raised at the same time.

Position of
part.

Dissection.—An incision along the base of the jaw on the right side (if it has not been made already) will readily allow the piece of integument in front of the sterno-mastoideus to be raised towards the middle line. Beneath the skin is the superficial fascia, containing the ramifications of the superficial cervical nerve. The nerve is to be followed forwards from its trunk, and the fat is to be taken away from the platysma muscle.

Dissection.

PLATYSMA MYOIDES.—The anterior part of the platysma, viz. from the sterno-mastoid muscle to the lower jaw, covers the greater portion of the anterior triangular space. The fibres have the same appearance in this as in the lower half of the muscle, but they are rather stronger. At the base of the jaw they are inserted between the symphysis and the masseter muscle ; while other and more posterior fibres are continued over the face, joining the depressor anguli oris and risorius, as far as the fascia covering the parotid gland or the cheek bone. Below the chin the fibres of opposite muscles cross for the distance of about an inch, but those that are superficial do not belong always to the same side. This part of the muscle is subcutaneous, and conceals the following nerves :—

Platysma
muscle in
front of
sterno-
mastoid.

Insertion
into jaw.

Crossing of
the fibres.

Superficial
cervical
nerve,

The *superficial cervical nerve* has been traced from its origin in the cervical plexus to its position on the fascia of the neck (p. 60); and the nerve may arise from the plexus by two pieces. Beneath the platysma it divides into an ascending and a descending branch, and is distributed on the front of the neck.

branches to
integuments
and platys-
ma of neck.

a. The *ascending branch* perforates the platysma, and ends in the integuments over the anterior triangle, about half way down the neck, as well as in the platysma. Whilst this branch is beneath the platysma it joins the facial nerve.

b. The *descending branch* likewise passes through the platysma, and is distributed below the preceding, reaching as low as the sternum.

Dissection.

Dissection.—Raise the platysma to the base of the jaw, and dissect out the cervical branches of the facial nerve that are beneath it. Clean also the deep fascia of the neck.

Branches of
facial nerve
to the neck.

The *infra-maxillary branches of the facial* or *seventh cranial nerve* (rami subcutanei colli) (p. 41) pierce the deep cervical fascia, and pass forwards beneath the platysma, forming arches across the side of the neck, which reach as low as the hyoid bone. Most of the branches end in the platysma, but a few filaments perforate it and supply the integument. Beneath the muscle there is a communication established between these branches of the facial and the offsets of the superficial cervical nerve.

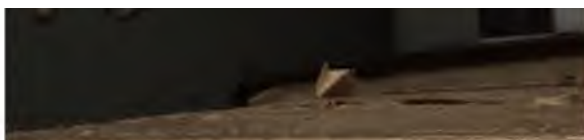
Cervical
fascia in
front of
sterno-
mastoid

The part of the *deep cervical fascia* in front of the sterno-mastoid is stronger than it is behind that muscle, and has the following disposition. Near the sternum the fascia forms a white firm membrane, which is attached to that bone; but higher in the neck it becomes thinner, and is fixed above to the lower jaw and the zygoma, covering also the parotid gland. From the angle and ramus of the jaw a piece is prolonged downwards, between the parotid and submaxillary glands, to join the styloid process; this piece is named *stylo-maxillary ligament*. Intermuscular partitions are sent between the muscles; and the layer beneath the sterno-mastoid is connected with the sheath of the cervical vessels. One of these strata, viz. that beneath the sterno-thyroid muscle, descends in front of the great vessels at the root of the neck to the arch of the aorta and the pericardium.

forms stylo-
maxillary
ligament
and sheath
of vessels.

Dissection of
anterior
triangle.

Dissection.—To define the anterior triangular space, take away the deep fascia of the neck, and clean the surface of the hyoid muscles that appear along the middle line, dissecting out at the same time the anterior jugular vein.



STERNO-CLEIDO-MASTOID MUSCLE.

67

external jugular. In the neck the anterior and external jugular veins communicate. There are two anterior veins, one for each side, though one is usually larger than the other, and at the bottom of the neck they are joined by a transverse branch. joins subclavian vein.

The STERNO-CLEIDO-MASTOID MUSCLE (fig. 9, ¹) forms the superficial prominence of the side of the neck, and divides the lateral surface of the neck into two triangular spaces. The muscle is narrower in the centre than at the ends, and is attached below by two heads of origin, which are separated by an elongated interval. The inner head is fixed by a narrowed tendon to the anterior part of the first piece of the sternum, and the outer head has a wide attachment to the sternal third of the clavicle. From this origin the heads are directed upwards, the internal passing backwards, and the external almost vertically, and are blended about the middle of the neck in a roundish muscle. Near the skull the muscle ends in a tendon, which is inserted into the base of the mastoid process at the outer aspect, and by a thin aponeurosis into a rough surface behind that process, as well as into the outer part of the upper curved line of the occipital bone. The borders of the muscle limit the triangular spaces of the neck, and the anterior one is the guide to the position of the common carotid artery. On its cutaneous surface the sterno-mastoid is covered by the common integuments and the platysma, by the external jugular vein and superficial branches of the cervical plexus (across the middle part), and by the deep fascia. If the muscle be cut through below and raised, it will be seen to lie on the following parts :—the clavicular origin lies over the anterior scalenus and omo-hyoid muscles ; and the sternal head conceals the depressors of the hyoid bone, and the common carotid artery with its vein and nerves. After the union of the heads, the muscle is placed over the cervical plexus, the middle scalenus, and the elevator of the angle of the scapula ; and near the skull, on the digastric and splenius muscles, with the occipital artery, and a part of the parotid gland. The spinal accessory nerve perforates the muscular fibres about the upper third. The extent of the attachment to the clavicle varies, and in some bodies it may reach even to the trapezius. Sterno-mastoid muscle has its origin at sternum, and clavicle, and insertion at skull. Guide to carotid artery. Position to other parts.

The OMO-HYOID MUSCLE crosses beneath the sterno-mastoidens, and consists of two fleshy bellies united by a small round intermediate tendon (fig. 8, ²). The origin of the muscle from the scapula, and the connections of the Omo-hyoid muscle begins at the scapula,

Contents of the space. In the area of the triangular interval, as it is above defined, are seen the larynx and pharynx in part, and many muscles converging towards the hyoid bone as a centre, some being above and some below it. Below are the depressors of that

Fig. 9.*



bone, viz. omo-hyoid, sterno-hyoid, and sterno-thyroid, 2 to 4; and above the os hyoides are the elevators of the bone, viz. mylo-hyoid, and digastric and stylo-hyoid. Connected with the back of the hyoid bone and the larynx are some of the constrictor muscles of the gullet.

* View of the anterior triangular space of the neck (from "Quain's Arteries"). 1. Sterno-mastoideus. 2. Sterno-hyoideus. 3. Anterior belly of the omo-hyoideus. 4. Thyro-hyoideus. 5. Common carotid artery dividing. 6. Internal jugular vein. 7. External jugular vein. —In Mr. Quain's drawing the sterno-mastoid is partly cut through.

The carotid blood-vessels, 6 and 7, occupy the hinder and deeper part of the space along the side of the sterno-mastoid muscle, and their course would be marked on the surface by a line from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process. As high as the level of the cricoid cartilage, the vessels are covered by the depressor muscles of the os hyoides; but beyond that spot they are concealed by the common coverings of the space, and by the sterno-mastoid muscle which, before the parts are displaced, overhangs or conceals the vessels—in some bodies to a level with the hyoid bone, and in others as far as the parotid gland.

For a short distance after its exit from beneath the muscles at the root of the neck, the common carotid artery remains a single trunk, 6, but opposite the upper border of the thyroid cartilage it divides into two large vessels, external and internal carotid. From the place of division these trunks are continued onwards, beneath the digastric and stylo-hyoid muscles, to the interval between the jaw and the mastoid process. At first the trunks lie side by side, the vessel destined for the internal parts of the head being the more posterior of the two, but above the digastric muscle one becomes superficial to the other. The more superficial artery (external carotid) furnishes many branches to the neck and the outer part of the head, viz. some forwards to the larynx, tongue, and face; others backwards to the occiput and ear; and others upwards to the head. The deeper trunk (internal carotid) ascends to the head without branching, and is distributed in the interior of the skull.

But the common carotid does not always divide, as here said, for it sometimes ascends as an undivided trunk (though very rarely), furnishing offsets to the neck and head. Or the point of branching of the vessel may be moved from the upper border of the thyroid cartilage, either upwards or downwards, so that the trunk of the carotid may remain undivided till it is beyond the os hyoides, or end in branches opposite the cricoid cartilage. The division beyond the usual place is more frequent than the branching short of that spot.

In close contact with the outer side of both the common trunk and the internal carotid artery, is the large internal jugular vein, which receives branches in the neck corresponding with some of the branches of the superficial artery; but in some bodies the vein covers the artery, and

Carotid artery in space. Course.

Coverings.

Bifurcation.

Position of two trunks to one another.

Branches.

Changes in the place of division of carotid.

Jugular vein

- middle, and posterior ; they extend from the first two ribs to the transverse processes of certain cervical vertebræ.
- Scalenus anticus.** The SCALENUS ANTICUS (fig. 10, ¹) extends from the first rib to the lower cervical vertebræ, and is somewhat conical in shape. It is attached by its apex to the inner border and the upper surface of the first rib, so as to surround the rough surface or projection on this aspect of the bone ; and by its base it is *inserted* into the anterior transverse processes (parapophyses) of four of the cervical vertebræ, viz. sixth, fifth, fourth, and third. More deeply seated below than above, the muscle is concealed by the clavicle and the subjacent muscle (subclavius), and by the clavicular part of the sterno-mastoid : the phrenic nerve lies along the cutaneous surface of the muscle, and the subclavian vein crosses over it near the rib. Along the inner border is the internal jugular vein. Beneath the scalenus are the pleura, the subclavian artery, and the nerves of the brachial plexus. The insertion into the vertebræ corresponds with the origin of the rectus capitis anticus major muscle.
- Origin from first rib ;**
- insertion ;**
- connections with muscles,**
- vessels,**
- and nerves.**
- Scalenus medius. Origin.** The SCALENUS MEDIUS MUSCLE (fig. 10, ²) is larger than the anterior, and extends farthest of all on the vertebræ. Inferiorly it is attached to the inner border of the first rib ; and to a groove on the upper surface of the rib, which extends obliquely forwards for one inch and a half from the tubercle to the anterior border. The muscle ascends behind the spinal nerves, and is *inserted* into the tips of the posterior transverse processes (diapophyses) of the six lower cervical vertebræ. In contact with the anterior surface are the subclavian artery and the spinal nerves, together with the sterno-mastoid muscle ; whilst the posterior surface touches the posterior scalenus, and the deep lateral muscles of the back of the neck. The outer border is perforated by the nerves of the rhomboid and serratus muscles.
- Insertion.**
- Parts in contact with it.**
- Scalenus posticus. Attachments.** The SCALENUS POSTICUS is inconsiderable in size, and appears to be but part of the preceding. It is attached below by a slip, about half an inch wide, to the upper border of the second rib, in front of the elevator of that bone ; and it is inserted above with the scalenus medius into two or three of the lower cervical vertebræ.
- Subclavian artery ;**
- extends to upper limb,**
- The SUBCLAVIAN ARTERY (fig. 10) is a given part of the large vessel supplying the upper limb with blood, to which this name has been applied from its position beneath the clavicle. This vessel, 8, is derived from the branching of the innominate artery behind the sterno-clavicular articula-

external jugular. In the neck the anterior and external jugular veins communicate. There are two anterior veins, one for each side, though one is usually larger than the other, and at the bottom of the neck they are joined by a transverse branch. joins subclavian vein.

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The OMO-HYOID MUSCLE crosses beneath the sterno-mastoideus, and consists of two fleshy bellies united by a small round intermediate tendon (fig. 8, ²). The origin of the muscle from the scapula, and the connections of the Omo-hyoid muscle begins at the scapula.

vessel may be divided into three parts: the first extending from the sterno-clavicular articulation to the inner border of the anterior scalenus; the second, beneath the scalenus; and the third, from the outer border of that muscle to the lower edge of the first rib.

First part
internal to
scalenus is
deep.

First part.—Internal to the anterior scalenus the artery lies deeply in the neck, and ascends slightly from the level of its origin. Between the vessel and the surface will be found the common tegumentary coverings and the deep fascia, the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, and a deep process of fascia from the inner border of the scalenus muscle. Crossing the artery near the scalenus are the large internal jugular, and the small vertebral vein; and internal to these veins is the pneumo-gastric nerve. Some branches of the sympathetic are likewise placed in front of the vessel. This part of the subclavian lies over the longus colli muscle, though at some distance from it, and separated from it by fat, by the recurrent branch of the pneumo-gastric nerve, and by the sympathetic nerve. Below the artery, both in this and the next part, is the pleura, which ascends into the arch formed by the vessel. Three branches arise from the subclavian in this part of its extent.

Parts in
front,

behind,

below.

Branches.

Second part
beneath
scalenus.
Parts in
front,

Second part.—Beneath the scalenus the vessel is less deep than it is when internal to that muscle, and at this spot it rises highest above the clavicle. The second part, like the first, is covered by the integuments, platysma, and deep fascia; then by the clavicular origin of the sterno-mastoideus; and lastly by the anterior scalenus with the phrenic nerve. Behind the vessel is the middle scalenus. And above it, in the interval between the scaleni, are the large trunks of the lower cervical nerves; with the exception of the trunk formed by the union of the last cervical and first dorsal, which lies between the artery and the middle scalenus. The subclavian vein is below the level of the artery and separated from it by the anterior scalenus muscle. From this part of the subclavian one branch takes its origin.

behind,
above.

One branch.

Third part

Third part.—Beyond the scalenus the subclavian artery is contained in the clavicular part of the posterior triangular space (p. 58), and is nearer the surface than in the rest of its course. This part of the vessel is enclosed in a tube of the deep cervical fascia, which it receives as it passes from between the scaleni. It is comparatively superficial whilst in the space before mentioned, for it is covered only by the integuments, the platysma and deep fascia, with some

its superfi-
cial.
Parts cover-
ing it;

Directions.—The remaining parts included in this section are the scaleni muscles and the subclavian blood-vessels, with the cervical nerves and the carotid blood-vessels. The student may examine them in the order here given.

Dissection.—Supposing the sterno-mastoid to be cut, the fat and fascia are to be taken away from the lower part of the neck, so as to prepare the scaleni muscles with the subclavian vessels and their branches. By means of a little dissection the anterior scalenus muscle will be seen ascending from the first rib to the neck, having the phrenic nerve and subclavian vein in front of it, the latter crossing it near the rib. The part of the subclavian artery that is on the inner side of the scalenus is then to be cleaned, care being taken not only of its branches, but of the branches of the sympathetic nerve which course from the neck to the chest. This dissection will be facilitated by the removal of a part or the whole of the clavicle. All the branches of the artery are in general easily found, except the superior intercostal, which is to be sought in the thorax in front of the neck of the first rib. On the branch (inferior thyroid) ascending to the thyroid body, or near it, is the middle cervical ganglion of the sympathetic, and the dissector should follow downwards from it the small nerves to the thorax. Only the origin and first part of the course of the arterial branches can be now seen; their termination is met with in other stages of this dissection, or in the dissection of the other parts of the body. In this stage the student should seek the small right lymphatic duct that opens into the subclavian vein near its junction with the jugular. A notice of it will be given with the lymphatics of the thorax.

The outer part of the subclavian artery having been already prepared, let the dissector remove more completely the fibrous tissue from the nerves of the cervical and brachial plexuses. From the brachial plexus trace the small branch to the subclavius muscle, and the branches to the rhomboid and serratus muscles which pierce the middle scalenus. If it is thought necessary, the anterior scalenus may be cut through after the artery has been studied.

From the cervical plexus, besides muscular branches, the student should seek small twigs to join the descendens noni; and should define the roots of the phrenic nerve. Lastly, let the surface of the middle scalenus muscle be cleaned, as it lies beneath the cervical nerves.

The SCALeni muscles are usually described as three in number, and are named from their relative position, anterior,

Dissection
of the sub-
clavian
artery

and
branches.

Of lymphatic
duct.

Dissection
of brachial
plexus.

Dissection
of cervical
plexus.

Number of
scaleri
muscles.

middle, and posterior ; they extend from the first two ribs to the transverse processes of certain cervical vertebræ.

Scalenus
anticus.

Origin from
first rib ;

insertion ;

connections
with
muscles,

vessels,

and nerves.

The SCALENUS ANTICUS (fig. 10, ¹) extends from the first rib to the lower cervical vertebræ, and is somewhat conical in shape. It is attached by its apex to the inner border and the upper surface of the first rib, so as to surround the rough surface or projection on this aspect of the bone ; and by its base it is *inserted* into the anterior transverse processes (parapophyses) of four of the cervical vertebræ, viz. sixth, fifth, fourth, and third. More deeply seated below than above, the muscle is concealed by the clavicle and the subclavian muscle (subclavius), and by the clavicular part of the sterno-mastoid : the phrenic nerve lies along the cutaneous surface of the muscle, and the subclavian vein crosses over it near the rib. Along the inner border is the internal jugular vein. Beneath the scalenus are the pleura, the subclavian artery, and the nerves of the brachial plexus. The insertion into the vertebræ corresponds with the origin of the rectus capitis anticus major muscle.

Scalenus
medius.
Origin.

Insertion.

Parts in
contact
with it.

The SCALENUS MEDIUS MUSCLE (fig. 10, ²) is larger than the anterior, and extends farthest of all on the vertebral column. Inferiorly it is attached to the inner border of the first rib, and to a groove on the upper surface of the rib, extends obliquely forwards for one inch and a half to a tubercle to the anterior border. The muscle ascends and is *inserted* into the tips of the posterior transverse processes (diapophyses) of the sixth, fifth, and fourth cervical vertebræ. In contact with the anterior surface of the subclavian artery and the spinal nerves, together with the sterno-mastoid muscle ; whilst the posterior border touches the posterior scalenus, and the deep lateral border of the back of the neck. The outer border is posterior to the nerves of the rhomboid and serratus muscles.

Scalenus
posticus.
Attach-
ments.

The SCALENUS POSTICUS is inconsiderable and appears to be but part of the preceding. It arises from below by a slip, about half an inch wide, from the inner border of the second rib, in front of the eleventh rib ; and it is inserted above with the scalenus anterior into two or three of the lower cervical vertebræ.

Subclavian
artery ;

extends to
upper limb,

The SUBCLAVIAN ARTERY (fig. 10) is a given large vessel supplying the upper limb with blood. This name has been applied from its position relative to the clavicle. This vessel, 8, is derived from the innominate artery behind the sterno-

tion, and the part of it named subclavian extends as far as the lower border of the first rib. To reach the limb the artery crosses the lower part of the neck, taking an arched

crosses lower part of the neck.

Fig. 10.*



course over the bag of the pleura and the first rib, and between the scaleni muscles. For the purpose of describing the numerous connections of the subclavian artery the

and is divided into three parts.

* A view of the common carotid and subclavian arteries (from Quain's "Arteries"). 1. Anterior scalenus, with the phrenic nerve on it. 2. Middle scalenus. 3. Levator anguli scapulae. 4. Omohyoideus. 5. Rectus capitis anticus major. 6. Common carotid artery. 7. Subclavian vein. 8. Subclavian artery. 9. Digastric muscle. 10. Parotid gland. 11. Submaxillary gland. 12. Thyroid body. 13. Trapezius muscle reflected.

external jugular vein. But the inferior thyroid vein begins in a plexus connected with the thyroid body, and descends in front of the trachea, beneath the muscles covering this tube, to end in the innominate vein.

4. The *superior intercostal artery* arises from the posterior part of the subclavian, and bends downwards over the neck of the first rib to the thorax. Its distribution to the first two intercostal spaces will be seen in the thorax.

Arising in common with this branch is the *deep cervical artery* (art. profunda cervicis). Analogous to the dorsal branch of an intercostal artery (Quain), it passes backwards between the transverse process of the last cervical vertebra and the first rib, and ends beneath the complexus muscle at the posterior part of the neck.

The *SUBCLAVIAN VEIN* has nearly the same limits as the artery of the same name, viz., from the lower border of the first rib to the sterno-clavicular articulation. It is a continuation upwards of the axillary vein, and ends by joining the internal jugular to form the innominate vein. Its course is nearly straight, and commonly below the level of the artery, from which it is separated by the anterior scalenus muscle.

The anterior and external jugular join this vein outside the scalenus, and the vertebral vein enters it inside that muscle. Into the angle of union of the subclavian and jugular veins the right lymphatic duct opens; and at the same spot, on the left side, is the entrance of the large lymphatic duct. A pair of valves exists in this vein at about an inch from its ending, and outside the opening of the external jugular vein.*

It should be borne in mind that not unfrequently the vein is as high in the neck as the third part of its companion artery; and that the vein has been seen twice with the artery beneath the anterior scalenus.

The *ANTERIOR PRIMARY BRANCHES OF THE CERVICAL NERVES* spring from the common trunks in the intervertebral foramina, and appear on the side of the neck between the intertransverse muscles. These spinal nerves are eight in number, and are equally divided between the cervical and the brachial plexus; the highest four being combined in the former, and the remaining nerves in the latter plexus.

* See a Paper on the Valves in the Veins of the Neck, in the Edin. Med. Journal of Nov. 1856, by Dr. Struthers.

superficial nerves of the cervical plexus, and the external jugular vein; but near its termination the vessel gets under ^{beneath,} cover of the suprascapular artery and vein, and the clavicle and subclavius muscle. In the third part of its course the artery rests on the surface of the first rib. Above the vessel ^{above and} is the brachial plexus, and below it is the subclavian vein. ^{below.} Usually no branch leaves the last part of the artery.

Peculiarities.—There are some peculiarities affecting the origin, the course, and the level in the neck of the subclavian artery. ^{Peculiarities of origin of the trunk}

With reference to origin. The level at which it springs from the innominate trunk may vary; so that in one case it will be above the sterno-clavicular articulation, in another, below that joint. Or the artery may spring as a separate trunk from the arch of the aorta; and in such a state of the parts, the vessel takes a deeper place than usual to reach the scaleni muscles:—a condition that will be referred to with the arch of the aorta in the thorax. It has been before said (p. 58), that the artery may be in ^{course and} front of the scalenus or in its fibres; or that it may be placed one ^{level.} inch and a half above the level of the clavicle.

Branches of the subclavian.—Usually there are four ^{Branches of subclavian artery.} branches to the subclavian artery. Three branches arise

from the first part of the arterial trunk;—one (vertebral) ascends to the head; another (internal mammary) descends to the chest; and the remaining one (thyroid axis) is a short thick trunk, which furnishes branches inwards and outwards. These arise commonly near the scalenus muscle, so as to leave an interval at the origin free from offsets. ^{Origin of the branches.} This interval varies in length, being from half an inch to an inch in the greater number of cases; and its extremes range from somewhat less than half an inch to an inch and three quarters. But in some instances the branches are scattered over the whole extent of this part of the artery (Quain).^{*} The fourth branch (superior intercostal) arises from the second part of the artery, viz. that beneath the anterior scalenus, and gives off the deep cervical branch. If there is a branch present on the third part of the artery, it is commonly the posterior scapular: if more than one, the internal mammary, to which some offsets belonging usually to the thyroid axis will be added.

1. The *vertebral artery* is generally the first and largest ^{Vertebral artery in the neck.} branch of the subclavian, and arises from the upper and posterior part of the vessel. Ascending between the con-

* The student is referred for fuller information respecting the peculiarities of the vessels, and the practical applications to be deduced from them, to the original and valuable work on the Anatomy of the Arteries of the Human Body, by Richard Quain, F.R.S.

beneath the levator anguli scapulæ to its destination. Branches are given usually from this nerve to the levator anguli scapulæ.

Nerve of serratus,

3. The *nerve of the serratus* (posterior thoracic nerve : external respiratory nerve of Bell) is contained in the scalenus, like the preceding, and arises from the fifth and sixth nerves, near the intervertebral foramina. Piercing the fibres of the scalenus lower than the preceding branch, the nerve is continued behind the brachial plexus, and enters the serratus magnus muscle on the axillary surface.

Nerves of scaleni and longus colli,

4. *Branches for the scaleni and longus colli muscles.*—These are small twigs that are seen when the anterior scalenus is divided ; they arise from the trunks of the nerves as soon as these leave the spinal canal.

Suprascapular nerve.

5. The *suprascapular nerve* is larger than either of the others. It arises near the subclavian branch from the same cord of the plexus, viz., that formed by the fifth and sixth nerves. Its destination is the dorsum of the scapula, on which it will be dissected with the arm.

Offset to the phrenic.

Occasionally an offset comes from the trunk of the fifth cervical nerve, and joins the phrenic on the anterior scalenus muscle.

Cervical plexus

The CERVICAL PLEXUS is formed by the anterior primary branches of the first four cervical nerves. Situate at the upper part of the neck, it lies beneath the sterno-mastoid muscle, and on the middle scalenus and the levator anguli scapulæ. Its appearance differs much from that of the brachial plexus, for it resembles a network more than a bundle of large cords. The following is the general arrangement of the nerves in the plexus :—each nerve, except the first, divides into an ascending and descending branch, and these unite with similar parts of the contiguous nerves, so as to give rise to a series of arches. From these loops or arches the different branches arise.

forms a network,

Arrangement of the nerves.

Its offsets are superficial,

Branches.—The branches of the plexus are both superficial and deep. The superficial set (fig. 8) are described with the triangular space of the neck, as consisting of ascending and descending nerves (p. 59). In this stage of the dissection the ascending branches are seen to spring from the union of the second and third nerves, and the descending branches to come from the loop between the third and fourth nerves. The deep set of branches remain to be examined.

and deep.

Deep

The DEEP BRANCHES OF THE PLEXUS are both muscular and

communicating, and may be arranged into an internal and an external series. branches are :

A. INTERNAL SERIES.—1. The *phrenic* or muscular nerve of the diaphragm (fig. 10) is derived from the fourth, or third and fourth nerves of the plexus, and it may be joined by a fasciculus from the fifth cervical nerve. Descending obliquely on the surface of the anterior scalenus from the outer to the inner edge, it enters the chest in front of the internal mammary artery, but behind the subclavian vein, and traverses that cavity to reach the diaphragm. At the lower part of the neck the phrenic nerve is joined by a filament of the sympathetic, and sometimes by an offset of the nerve to the subclavian muscle. Phrenic nerve,

2. The *branches communicating with the descendens noni* are two in number. One of them arises from the second, and the other from the third cervical nerve; they are directed inwards either over or under the internal jugular vein, and communicate with the descending muscular branch (*descendens noni*) of the hypoglossal nerve. Nerves to join descendens noni,

3. *Muscular branches* are furnished to the recti muscles; these arise from the loop between the first two nerves, and from the trunks of the other nerves close to the intervertebral foramina. Branches to recti,

4. Some *connecting branches* pass from the loop between the first two nerves to the sympathetic, and to the cranial nerves near the base of the skull: these will be afterwards described. Branches to other nerves.

B. EXTERNAL OR POSTERIOR SERIES.—1. *Muscular branches* are given from the second nerve to the sterno-mastoideus; from the third nerve to the levator anguli scapulae; and from the third and fourth nerves to the trapezius. Further, some small branches supply the substance of the middle scalenus. Branches to muscles,

2. *Connecting branches with the spinal accessory nerve.*—The communications are numerous between this cranial and the spinal nerves. First, in the sterno-mastoid muscle; next, in the posterior triangular space; and lastly, beneath the trapezius. The union with the branches that are distributed to the trapezius has the appearance of a plexus. Branches joining spinal accessory.

The COMMON CAROTID ARTERY is the leading vessel for the supply of blood to the neck and head (fig. 10, *), and is remarkable in not furnishing collateral branches. The origin of the vessel is different on opposite sides of the body, beginning on the right side at the lower part of the neck, and on the left side in the thorax. Common carotid artery.

Origin.	The vessel of the right side commences opposite the sterno-clavicular articulation at the bifurcation of the innominate artery, and ends at the upper border of the thyroid cartilage by dividing into the two trunks before
Course.	seen, viz. external and internal carotid. The course of the artery is along the side of the trachea and larynx, gradually diverging from the vessel on the opposite side in consequence
Situation.	of the increasing size of the larynx ; and its position will be marked by a line from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process. Contained in a sheath of cervical fascia, with the internal jugular vein to the outside, and the pneumo-gastric nerve between the two, the carotid artery has the following
Parts covering it,	connections with the surrounding parts :—As high as the cricoid cartilage the vessel is deeply placed, and is concealed by the common coverings of the skin, platysma and fasciæ, and by the muscles at the lower part of the neck, viz., sterno-mastoid (sternal origin), sterno-hyoid, sterno-thyroid, and omo-hyoid ; and beneath the muscles by the middle thyroid vein. But above the cricoid cartilage to its termination the artery is covered by the sterno-mastoid with the common investments of the part ; superficial to it here is the descendens noni nerve, and crossing the upper part are offsets of the superior thyroid artery with the accompanying vein. The vessel rests mostly on the longus colli muscle, but close to its ending on the rectus capitis anticus major ; on the sympathetic nerve and its branches ; and on the recurrent nerve and the inferior thyroid artery.
beneath it,	To the inner side of the carotid lie the trachea and larynx, with the œsophagus and pharynx and the thyroid body, the last overhanging the vessel by the side of the larynx. Along the outer side of the carotid sheath is a chain of lymphatic glands.
and on its sides.	
Internal jugular vein	INTERNAL JUGULAR VEIN.—This vein extends upwards to the base of the skull by the side of the carotid blood-vessels, but only the part of it that accompanies the common carotid artery is now seen. Placed behind or posterior to its artery, the vein ends below by uniting with the subclavian in the innominate vein. Its proximity to the carotid is not
lies close to side of artery,	equally close in all the extent of the vessel, for at the lower part of the neck the vein inclines backwards, leaving a space between it and the artery, in which the vagus nerve is seen
except below.	about midway between the two. Sometimes the vein is superficial to the artery as on the left side. This part of the vein is marked by a dilatation or sinus, but near its

ending below it becomes contracted, and is provided with a pair of valves (Struthers).

In this part of its course the vein receives the superior Branches, and middle thyroid branches.

Peculiarities.—Some of the following peculiarities of the common carotid may be met with. Its origin on the right side may be above or below the point here stated; or it may be transferred to the arch of the aorta, or to the left carotid in the thorax. Mention has been made of the difference in the place of bifurcation, and of the fact that, occasionally, the common carotid artery is not divided into two. (See page 65.)

Instead of one, there may be two trunks issuing from beneath the hyoid muscles, for the common carotid has been found divided in one case after an extent of one inch and a half. As an extremely rare occurrence its usual terminal branches, the external and internal carotids, may arise as distinct arteries from the arch of the aorta.

Usually the common carotid is without branch, but it may give its origin to the superior thyroid, the inferior thyroid, or the vertebral artery.

Dissection.—The dissector may next trace out completely the trunk of the external carotid, and follow its branches until they disappear beneath different parts. Afterwards he may separate from one another the digastric and stylo-hyoid muscles, which cross the carotid; and may define their origin and insertion.

The DIGASTRIC MUSCLE (fig. 10, ^b) consists of two fleshy bellies, united by an intervening tendon, whence its name. The posterior belly, the larger of the two, arises from the groove beneath the mastoid process; whilst the anterior belly takes origin from the base of the lower jaw, on the side of the symphysis. From these places of origin the fibres are directed to the intervening tendon:—those of the posterior belly are the longest and are inclined obliquely forwards, and those of the anterior belly pass more vertically downwards. The tendon of the muscle is surrounded by fibres of the stylo-hyoideus; it is united to its fellow and to the os hyoides by means of an aponeurotic expansion, which keeps in position the arch of the muscle, and is attached to the body and a part of the great cornu of the hyoid bone. The arch formed by the digastric is superficial, except at the outer part, where it is beneath the sterno and trachelo-mastoid muscles. The posterior belly crosses the carotid vessels and the accompanying veins and nerves; and is placed across the anterior triangular space of the neck in a line from the mastoid process to a little below the middle of the lower border of the hyoid bone; along its lower border will be found

which are joined by a tendon.

Posit other

the occipital artery and the hypoglossal nerve, the former passing backwards, the latter forwards. The anterior belly rests on the mylo-hyoid muscle.

The muscle bounds a space

that contains parotid and sub-maxillary glands.

Stylo-hyoideus.

Origin.

Insertion.

Surrounds digastric tendon.

Ninth nerve in the anterior triangle.

Its branches here are muscular.

Branch to lower hyoid muscles

is joined with cervical nerves

by inter-communicating

The digastric muscle describes an arch across the side of the neck, and forms the lower boundary of a space which reaches upwards to the jaw and the mastoid process, and to the base of the skull in front of the ear. This space is divided into two parts by the stylo-maxillary ligament. In the posterior portion are contained the parotid gland, 10, and the vessels and nerves in connection with it (p. 30); in the anterior are the submaxillary gland, 11, and the facial vessels, and deeper still the muscles between the chin and the hyoid bone.

The STYLO-HYOID MUSCLE is thin and slender, and has the same position as the posterior belly of the digastric. It arises from the outer surface of the styloid process, near the base or about the middle, and is inserted into the body of the os hyoides. The muscle has the same connections as the posterior belly of the digastric; and its fleshy fibres are usually perforated by the tendon of that muscle. In many bodies the stylo-hyoid muscle is absent.

The HYPOGLOSSAL NERVE (ninth cranial) may be now examined, at least that part of it which is seen in the anterior triangle of the neck. Appearing at the lower edge of the digastric muscle, the nerve hooks round the occipital artery; it is then directed forwards to the tongue below the digastric, and disappears in front beneath the mylo-hyoid muscle. As the nerve crosses the neck, it lies over the carotid vessels; and near the cornu of the os hyoides it crosses the lingual artery, so as to become highest of the two.

Branches.—In this part of its course the nerve gives the descendens noni branch and a small muscular offset to the thyro-hyoideus.

The *descending branch* (ram. descend. noni) arises from the trunk of the hypoglossal on the outer side of the carotid artery, and descends on the front, or in the sheath of the vessel, to about the middle of the neck, where it is joined by the communicating branches of the cervical nerves. After the union of the spinal nerves offsets are supplied to the lower hyoid muscles, viz. omo-hyoid (both bellies), sterno-hyoid, and sterno-thyroid. Sometimes another offset is continued to the thorax, where it joins the phrenic and cardiac nerves. The connection between the descendens noni and the spinal nerves is formed by two or more cross

filaments, so as to construct an arch with the concavity fibres upwards ; and an interchange of filaments between the two nerves has been described.

The EXTERNAL CAROTID ARTERY (fig. 9) springs from the bifurcation of the common carotid at the upper border of the thyroid cartilage, and furnishes branches to the face, the neck, and the outer parts of the head. External carotid vessel.

From the place of origin the vessel ascends to the interval between the jaw and the mastoid process, and ends near the condyle of the jaw in the internal maxillary and temporal branches. In this course the artery lies at first to the inner side of the internal carotid, but it afterwards becomes superficial to this vessel ; and its direction is somewhat arched forwards, though the position would be marked sufficiently by a line from the front of the meatus of the ear to the cricoid cartilage. Course and direction.

At first the external carotid is comparatively superficial, and easily reached from the surface, being overlaid only by the sterno-mastoideus and the common coverings of the anterior triangular space, viz. the skin, the superficial and deep fasciæ with the platysma, and the superficial nerves. But above the situation of a line extended from the mastoid process to the hyoid bone, the carotid artery is crossed by the digastric and stylo-hyoid muscles with the hypoglossal nerve ; and still higher it enters the substance of the parotid gland, where it lies beneath the facial nerve and the external jugular vein. The external carotid is also crossed by the facial and lingual branches of veins joining the internal jugular trunk. At first the artery is situate over the superior laryngeal nerve, and is unsupported by muscular fibre, though it rests against the pharynx ; but above the angle of the jaw it is placed over the styloid process and the glosso-pharyngeal nerve, which separate it from the internal carotid. To the inner side of the vessel at first is the pharynx, and still higher are the ramus of the jaw and the stylo-maxillary ligament. In certain conditions a companion vein from the temporal and internal maxillary branches (p. 31) will accompany the arterial trunk. Parts superficial to it, beneath it, and on inner side.

The branches of the external carotid are numerous, and are classed into an anterior, posterior, and ascending set. The anterior set comprise branches to the thyroid body, the tongue, and the face, viz. superior thyroid, lingual, and facial arteries ; in the posterior set are the occipital and posterior auricular branches ; and the ascending set Its branches are anterior, posterior, and ascending :

include the ascending pharyngeal, temporal, and internal maxillary arteries. Besides these, the carotid gives other branches to the sterno-mastoid muscle and the parotid gland.

change in
origin

and in
number.

Branches
now seen
are

Superior
thyroid,

has offsets
to

the hyoid
bone,

sterno-mas-
toid muscle,

to larynx,

to crico-
thyroid
membrane.

Accompany-
ing vein.

Facial
artery,

The regular origin of the branches, as this will be described below, may be departed from by means of the closer aggregation of the branches on the trunk of the carotid. And further, the usual number may be diminished by two or more taking origin in common; or the number may be increased by some of the secondary offsets being transferred to the parent trunk.

All the branches, except the ascending pharyngeal, lingual, and internal maxillary, may be now examined; but those three will be described afterwards with the regions they occupy.

The *superior thyroid artery* arises near the cornu of the os hyoides, and runs downwards on the inner side of the common carotid artery, passing beneath the omo-hyoid, sterno-hyoid, and sterno-thyroid muscles, to the thyroid body, to which it is distributed on the anterior aspect. This branch is superficial in the anterior triangle, and furnishes offsets to the lowest constrictor as well as to the muscles beneath which it lies, in addition to the following named branches:—

a. The *hyoid branch* is very inconsiderable in size, and runs inwards below the hyoid bone: it supplies the parts attached to that bone, and anastomoses with the vessel of the opposite side.

b. A branch for the *sterno-mastoid muscle* lies in front of the sheath of the common carotid artery, and is distributed chiefly to the muscle from which it takes its name.

c. The *laryngeal branch* pierces the membrane between the hyoid bone and thyroid cartilage, with the superior laryngeal nerve, and ends in the interior of the larynx.

d. A small *crico-thyroid branch* is placed on the membrane between the cricoid and thyroid cartilages, and communicates with the corresponding artery of the opposite side, forming an arch.

The *superior thyroid vein* commences in the larynx and the thyroid body, and crosses the end of the common carotid artery to open into the internal jugular vein.

The *facial artery* arises above the lingual, and is directed upwards over the lower jaw to the face. In the neck the artery passes beneath the digastric and stylo-hyoid muscles, and is afterwards received on the submaxillary gland, on

which it makes a remarkable sigmoid turn. Its disposition in the face has been examined (p. 28). The cervical part of the artery gives branches to the pharynx, and to the structures below the jaw, viz. :—

a. The *inferior palatine branch* ascends to the pharynx beneath the jaw, passing between the stylo-glossus and stylo-pharyngeus muscles; furnishing a branch to the tonsil, it is distributed to the soft palate. This branch frequently arises from the ascending pharyngeal artery.

b. The *tonsillar branch* is smaller than the preceding, and ascends between the internal pterygoid and stylo-glossus muscles. Opposite the tonsil it perforates the constrictor muscle, and ends in offsets to that body.

c. *Glandular branches* are supplied to the submaxillary gland from the part of the artery in contact with it.

d. The *submental branch* arises near the inferior maxilla, and passes forwards on the mylo-hyoideus to the anterior belly of the digastric muscle, where it ends in branches: some of these turn over the jaw to the chin and lower lip; and the rest supply the muscles between the jaw and the hyoid bone, one or two perforating the mylo-hyoideus and anastomosing with the sublingual artery.

The *facial vein* (p. 29) joins the internal jugular vein. In the cervical part of its course it receives branches corresponding with the offsets of the artery. It often throws itself into the temporo-maxillary trunk.

The *occipital artery* is of considerable size, and is destined for the back of the head. It arises from the carotid opposite the facial branch, and near the lower border of the digastric muscle. From this spot the artery ascends to the inner part of the mastoid process of the temporal bone; next it turns horizontally backwards on the occipital bone, passing above the transverse process of the atlas; and finally becomes cutaneous near the middle line (p. 6). In the neck this artery passes beneath the digastric muscle and a part of the parotid gland; and crosses over the internal carotid artery, the jugular vein, and the spinal accessory and hypoglossal nerves.

The only offset from the artery in the front of the neck is a small *posterior meningeal branch* to the dura mater in the posterior fossa of the base of the skull. This ascends along the internal jugular vein, and enters the skull by the foramen jugulare (p. 17). The branches at the back of the neck will be afterwards seen.

The *occipital vein* begins at the back of the head (p. 6),

and has the same course as the artery; it communicates with the lateral sinus through the mastoid foramen, also with the diploic veins, and opens into the internal, sometimes into the external jugular vein.

Posterior
auricular
artery in
neck
supplies

The *posterior auricular artery* is smaller than the preceding branch, and takes origin above the digastric muscle. Ascending in the same direction as the occipital artery, viz. to the interval between the ear and the mastoid process, it divides finally into two branches for the ear and occiput (p. 6).

a branch to
the ear.

A small branch, *stylo-mastoid*, enters the foramen of the same name, and supplies the internal ear.

Vein with
artery.

The *vein* with the artery receives a *stylo-mastoid* branch, and terminates in the trunk formed by the temporal and internal maxillary veins.

Temporal
artery,

The *temporal artery* is in direction the continuation of the external carotid trunk, and is one of the terminal branches of that artery. Ascending under the parotid gland, in the interval between the ear and the articulation of the jaw, the vessel divides on the temporal fascia into anterior and posterior branches about two inches above the zygoma, and these are distributed to the front and side of the head (p. 5). The trunk of the artery gives offsets to the surrounding parts, viz. :—

branches to
parotid, to
articulation
of jaw, and
the ear.

a. Parotid branches are furnished to the gland which conceals the artery. *Articular* twigs are supplied to the articulation of the lower jaw; and other *muscular* branches enter the masseter. Some *anterior auricular* branches are distributed to the pinna and meatus of the external ear.

Branch to
face.

b. The transverse facial branch quits the temporal artery opposite the condyle of the jaw, and is directed forwards over the masseter muscle (p. 29); on the side of the face it supplies the muscles and integuments, and anastomoses with the facial artery.

Branch to
temporal
muscle

c. The middle temporal branch arises just above the zygoma, and pierces the temporal aponeurosis to enter the substance of the temporal muscle. In the muscle it anastomoses with branches of the internal maxillary artery.

and of the
temple.

d. A small branch of the temporal artery is likewise found between the layers of the temporal fascia; this becomes cutaneous near the orbicularis muscle.

Correspond-
ing vein.

The *temporal vein* commences on the side of the head (p. 6), and is contiguous to its companion artery. Near the zygoma it is joined by the middle temporal vein; next by other branches which are companions of the offsets of

the artery ; and finally it ends by uniting with the internal maxillary vein.

Directions.—The lower part of the neck will not be returned to again for some days, so that the dissector may stitch together the flaps of skin, when he has applied a fluid to preserve it.

SECTION VI.

PTERYGO-MAXILLARY REGION.

In this region are included the muscles superficial to and beneath the ramus of the lower jaw, together with the articulation of that bone. In contact with the muscles (pterygoid) beneath the ramus of the jaw, are the internal maxillary blood-vessels, and the inferior maxillary trunk of the fifth nerve. Contents of the region.

Dissection.—The masseter muscle, which is superficial to the jaw, comes first from without inwards. To see it the branches of the facial nerve and the transverse facial artery should be cut through, and turned backwards off the face. A little cleaning will suffice to show the fibres, and to define the origin and insertion of the muscle. Should there be in the mouth any of the material that made tense the fibres of the orbicularis, let it be removed. Dissection.

The MASSETER MUSCLE conceals the ramus of the lower jaw, and is divided into two portions, superficial and deep, by means of an aponeurosis which projects at the upper part into the muscular fibres. Masseter has two parts.

The superficial part *arises* from the anterior two thirds of the outer surface of the zygomatic arch, and its fibres are directed downwards and backwards to be *inserted* into the angle, and into the lower half of the ramus of the jaw on the outer aspect. The deeper part takes *origin* by fleshy fibres from the remaining third of the outer surface, and from all the posterior surface of the arch ; and its fibres, taking an opposite direction to those of the superficial part, are *inserted* into the outer surface of the coronoid process, and into the ramus of the jaw above the attachment of the other portion of the muscle. Superficial is directed backwards.
Deep part forwards.

The lower part of the masseter is subcutaneous, but the upper is partly concealed by the parotid gland (solia parotidis), and is crossed by Stenson's duct, and by the transverse Muscle nearly subcutaneous ;

lies on the
jaw.

To see sur-
face of tem-
poral
muscle.

facial vessels and the facial nerve. The anterior border projects over the buccinator muscle, and a quantity of fat resembling that in the orbit is found beneath it. The muscle covers the ramus of the jaw, and the masseteric branches of nerve and artery entering it at the under surface.

Dissection.—To lay bare the temporal muscle to its insertion, the following dissection may be made :—The temporal fascia is to be detached from the upper border of the zygomatic arch, and removed from the surface of the muscle. Next, the arch is to be sawn through in front and behind, so as to include its whole length ; and to be thrown down (without being cut off) with the masseter muscle still attached to it, by separating the fibres of that muscle from the upper part of the ramus of the jaw. In detaching the masseter

Fig. 11.*



muscle, the nerve and artery to it, which appear through the sigmoid notch, will be found. The surface and insertion of the temporal muscle may be then cleaned.

* Dissection of the pterygoid region (from Quain's Arteries). 1. Temporal muscle. 2. External pterygoid. 3. Internal pterygoid. 4. Buccinator. 5. Digastric and stylo-hyoid muscles cut and thrown back. 6. Common carotid dividing into external and internal trunks. 7. Internal maxillary artery (beneath the pterygoid) and its branches.



TEMPORAL MUSCLE.

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Afterwards, to see the insertion and extent of origin of the muscle, let the coronoid process be sawn off by a cut passing from the centre of the sigmoid notch nearly to the last molar tooth, so as to include the whole of the insertion of the muscle; and in thus proceeding let the student be careful of the buccal artery and nerve issuing from beneath it. Lastly, the coronoid process should be raised and the fat removed in order that the extent of the lower fibres of the temporal muscle, and their contiguity to the external pterygoid close below them, may be observed.

To see the insertion.

The *temporal muscle* has been before seen to occupy the upper part of the temporal fossa (p. 4); and by the previous dissection the lower part has been laid bare. The *origin* of the muscle is the following:—It occupies the whole of the temporal fossa, reaching up to the semicircular line on the side of the skull, and downwards to the crest on the outer aspect of the great wing of the sphenoid bone. From this extensive origin, as well as from the fascia over it, the fibres converge to a superficial tendon, which is *inserted* into the edge and the inner surface of the coronoid process, as well as into a groove on the same surface which reaches from the apex to near the last molar tooth. Behind the posterior border of the tendon are the masseteric vessels and nerve, and in front of it the buccal vessels and nerve: the last nerve perforates occasionally some of the fibres of the muscle.

Origin of temporal muscle.

Insertion.

Dissection.—For the display of the pterygoid muscles, it will be necessary to remove a piece of the ramus of the jaw. But first, the greater part of the temporal muscle is to be detached from the subjacent bone with the handle of the scalpel, and the deep temporal vessels and nerves to be sought in its fibres. A piece of the ramus of the jaw is next to be removed, but without injuring the vessels and nerves in contact with its inner surface, by sawing across the bone close to the condyle, and again close above the dental foramen; and to make the dental vessels and nerve secure from injury, the handle of the scalpel may be inserted between them and the bone, and carried downwards to their entrance into the foramen. The masseteric artery and nerve are liable to be cut in sawing the bone; should these be divided, turn them upwards for the present, and afterwards tie together the ends. After the loose piece of bone has been removed, and the subjacent parts freed from much fat, the pterygoid muscles will appear,—the external being directed outwards to the condyle of the jaw, and the internal,

To dissect pterygoid muscles.

which is parallel in direction to the masseter, being inclined to the angle of the jaw. In removing the fatty tissue, the student must be careful not to take away the thin fascia of the internal lateral ligament, which is beneath the ramus.

Position of
the parts.

Many vessels and nerves will be found in this region, with the following position to other parts. Crossing inwards over the external pterygoid muscle, is the internal maxillary artery, which distributes offsets upwards and downwards: sometimes this artery will be placed beneath the muscle. Escaping from beneath the lower border of the same muscle are the large dental and gustatory nerves, the latter being the more internal of the two; and appearing between the upper border of the muscle and the cranium, are the masseteric and deep temporal nerves. The buccal branch of nerve perforates the fibres of the external pterygoid near its inner attachment. Branches of the above-mentioned artery accompany these nerves. At the front of the space now dissected, coursing along the posterior part of the upper jaw, is the small posterior dental nerve with an artery.

Intermaxillary
band.

Between the jaws is the whitish narrow band of the pterygo-maxillary ligament, fig. 11, to which the buccinator and superior constrictor muscles are connected.

External
pterygoid is
horizontal.

The EXTERNAL PTERYGOID MUSCLE (fig. 11, ²) extends almost horizontally from the zygomatic fossa to the condyle of the lower jaw. Its *origin* is from the outer surface of the great wing of the sphenoid bone below the crest, and from the outer surface of the external pterygoid plate. The fibres are directed outwards and somewhat backwards, those attached to the upper margin of the spheno-maxillary fissure

Attach-
ments.

forming at first a separate bundle, and are *inserted* into the hollow in front of the neck of the lower jaw bone, and into the interarticular fibro-cartilage of the joint. Externally the muscle is concealed by the temporal muscle and the lower jaw, and the internal maxillary artery lies on it. By the deep surface it is in contact with the inferior maxillary nerve, with a plexus of veins, and with the internal lateral ligament of the joint of the jaw. The parts in contact with the borders of the muscle have been enumerated in the dissection of the region.

Insertion.

Contiguous
parts.

forming at first a separate bundle, and are *inserted* into the hollow in front of the neck of the lower jaw bone, and into the interarticular fibro-cartilage of the joint. Externally the muscle is concealed by the temporal muscle and the lower jaw, and the internal maxillary artery lies on it. By the deep surface it is in contact with the inferior maxillary nerve, with a plexus of veins, and with the internal lateral ligament of the joint of the jaw. The parts in contact with the borders of the muscle have been enumerated in the dissection of the region.

A second
head.

Sometimes the slip of the muscle, attached to the margin of the spheno-maxillary fissure and the root of the external pterygoid plate, is described as a separate head with an insertion mostly into the interarticular cartilage.

Internal
pterygoid is

The INTERNAL PTERYGOID MUSCLE (fig. 11, ³) is nearly parallel to the ramus of the jaw, and its fibres are longer

than those of the preceding muscle. *Arising* in the pterygoid fossa, and chiefly from the inner surface of the external pterygoid plate, the muscle is further attached below to the outer surface of the tuberosity of the palate bone, and to the tuberosity of the upper jaw bone. The fibres descend to be *inserted* into the angle and inner surface of the ramus of the jaw, as high as the inferior dental foramen. On the muscle are placed the dental and gustatory nerves, the dental artery, and the internal lateral ligament of the jaw. The deep surface is in connection below with the superior constrictor, and at its origin with the tensor palati muscle.

beneath the ramus of the jaw.

Attachments.

Vessels and nerves around.

Directions.—Before proceeding further in the dissection, the student may learn the anatomy of the articulation of the lower jaw.

TEMPORO-MAXILLARY ARTICULATION.—In this joint the condyle of the jaw is received into the anterior part of the hollow of the glenoid fossa of the temporal bone. The bones are retained in contact mostly by the strong muscles of the lower jaw; but the following ligaments are concerned in uniting them.

Joint of lower jaw.

The *external lateral* is a short ligamentous band, being but a part of the capsule, which is attached above to the tubercle at the root of the zygoma, and below to the outer side of the neck of the inferior maxilla.

External lateral and

The *internal lateral ligament* (fig. 12, ¹), is a long, thin, membranous band, which is not in contact with the joint. Superiorly it is connected by a pointed piece to the spinous process of the sphenoid, and the vaginal process of the temporal bone; and inferiorly it is inserted into the orifice of the dental canal in the lower jaw. This ligament lies beneath the ramus of the jaw, between it and the internal pterygoid muscle, and its origin is concealed by the external pterygoid muscle. Between the ligament and the jaw is the internal maxillary artery.

internal lateral ligament.

Fig. 12.*



* Ligaments of the jaw—an inner view (Bourguery and Jacob). 1. Internal lateral ligament. 2. Stylo-maxillary.

Capsule. Besides these ligaments there are some scattered fibres surrounding the articulation, which serve as a *capsular membrane*.

Dissection. *Dissection.*—After the external lateral ligament and the capsule of the joint have been removed, an interarticular fibro-cartilage, with a synovial membrane above and below it, will be exposed.

Fibro-cartilage ; The *interarticular fibro-cartilage* (fig. 13, ⁴) is adapted

Fig. 13.*

its form

and attach-
ments,



Two syno-
vial mem-
branes.

Stylo-maxil-
lary liga-
ment.

Dissection.

Dissection.—The condyle of the jaw is next to be disarticulated, still keeping the external pterygoid muscle uncut; and it with the attached muscle is to be drawn forwards so as to see the fifth nerve beneath; whilst cutting through the articular ligaments the dissector must be careful

* A view of the interior of the compound temporo-maxillary joint (Bourguery and Jacob). 3. Stylo-maxillary ligament. 4. Interarticular fibro-cartilage—the dark intervals above and below are lined by the synovial membranes.



INTERNAL MAXILLARY ARTERY.

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of the auriculo-temporal nerve close beneath. On drawing forwards the pterygoid muscle, and removing some fat, the dissector will find the trunk and branches of the inferior maxillary nerve. All the four small muscular branches of the nerve should be traced to the trunk in the foramen ovale of the sphenoid bone ; its auriculo-temporal branch should be followed backwards with care behind the articulation ; and the small chorda tympani should be found joining the posterior part of the gustatory nerve near the skull. The middle meningeal artery is to be sought beneath the external pterygoid ; and oftentimes the trunk of the internal maxillary artery will be found beneath that muscle.

The INTERNAL MAXILLARY ARTERY (fig. 11, ^a,) is one of the terminal branches of the external carotid, and takes a winding course beneath the lower jaw and the temporal muscle to the spheno-maxillary fossa, where it ends in branches for the face, the interior of the nose, and the palate and pharynx.

Internal maxillary artery.

At first the artery is directed inwards beneath the jaw, between that bone and the internal lateral ligament of the joint, and crosses the dental nerve. Next, the vessel winds over the external pterygoid muscle, being placed between it and the temporal muscle. And lastly, the artery enters the spheno-maxillary fossa between the processes of origin of the external pterygoid muscle. The trunk of the artery may be divided into three parts : one beneath the jaw, a second between the muscles, and a third in the spheno-maxillary fossa. The course of the artery is sometimes beneath, instead of over the external pterygoid muscle : in such instances the artery gains the spheno-maxillary fossa by coming upwards through the origin of the muscle covering it.

Course and connections.

Varies in its position.

The *branches* of this artery are very numerous, and are classed into three sets, corresponding with the divisions made in the trunk of the artery : thus one set arises beneath the jaw, another beneath the temporal muscle, and another in the spheno-maxillary fossa.

Branches are three sets.

Two branches, viz. the inferior dental and middle meningeal, leave the internal maxillary artery whilst it is in connection with the ramus of the jaw.

These beneath jaw,

1. The *inferior dental branch* descends between the internal lateral ligament and the jaw, and enters the foramen on the inner surface of the ramus, along with the dental nerve, to supply the teeth.

inferior dental ;

has a
branch to
mylo-hyoid
muscle.

a. As this artery is about to enter the foramen it furnishes a small twig, *mylo-hyoid branch*, to the muscle of that name ; this is conducted by a groove on the inner surface of the bone, in company with a branch from the dental nerve, to the superficial surface of the mylo-hyoid muscle, where it anastomoses with the submental artery.

Middle me-
ningeal
artery,

2. The *middle* or *great meningeal artery* is the largest branch, and arises opposite the preceding one. It ascends beneath the external pterygoid muscle, crossing the internal lateral ligament, and enters the skull through the foramen spinosum of the sphenoid bone. When in the skull the artery ends in branches which ascend to the vertex of the head, and supply the bone and the dura mater (p. 16).

ends in
skull,

Before the meningeal artery enters the skull, it furnishes the two following small branches :

but gives

branch to
tympanum,

a. The *tympanic branch* enters the tympanum through the Glasserian fissure, and is distributed in that cavity, anastomosing with the other arterial branches of the part.

to meninges.

b. The *small meningeal branch* arises near the skull, and passes through the foramen ovale with the inferior maxillary nerve ; it supplies the dura mater in the middle fossa of the skull.

Branches of
second part
are

The branches from the second part of the artery, viz. whilst it is between the muscles, are altogether muscular in their destination, and are named temporal, masseteric, buccal, and pterygoid.

to the
temporal
muscle ;

3. The *deep temporal arteries* are two in number (anterior and posterior), and each occupies the part of the temporal fossa indicated by its name. They ascend beneath the temporal muscle, and anastomose with the superficial temporal artery. The anterior also communicates, through the malar bone, with branches of the lachrymal artery. When the parent trunk has the unusual position beneath the pterygoid, the anterior branch is beneath that muscle, instead of over it.

to the
masseter ;

4. The *masseteric artery* is directed outwards with the nerve of the same name behind the tendon of the temporal muscle ; and passing through the sigmoid notch, enters the under surface of the masseter muscle. Its branches anastomose with the other branches to the muscle from the external carotid trunk.

to the buc-
cinator ;

5. The *buccal branch* quits the artery near the upper jaw, and in the unusual position of the artery it may perforate the fibres of the pterygoid ; it then descends beneath the coronoid process with its companion nerve, and is distributed

to the buccinator muscle and the side of the face, on which it joins the branches of the facial artery.

6. The *pterygoid* branches are uncertain in their position ; to pterygoid muscles. whether derived from the trunk or some of the branches of the internal maxillary, they enter the pterygoid muscles.

Of the branches that arise from the artery when it is about to enter, or has entered the spheno-maxillary fossa, only one, the superior dental, will be now described. The remainder will be examined with the superior maxillary nerve and Meckel's ganglion ; they are infraorbital (p. 108), and superior palatine, pterygo-palatine, spheno-palatine, and vidian, (SECTION 14). Branches of third part only one now seen.

7. The *superior* or *posterior* dental branch arises near the upper maxillary bone, and descends to the teeth with a tortuous course on the outer surface of that bone, along with a small branch of the superior maxillary nerve. For the most part its offsets enter the foramina in the bone, and supply the upper molar and bicuspid teeth, but some are furnished to the gums. A few branches reach the lining membrane of the antrum. Superior dental.

The INTERNAL MAXILLARY VEIN receives the veins that accompany the branches of the artery in the first two parts of its course. The veins of this region form a plexus—*pterygoid*, between the two pterygoid muscles, and in part between the temporal and external pterygoid muscles. This plexus communicates with the alveolar plexus and the facial vein by a large branch (anterior internal maxillary) ; and with the cavernous sinus in the interior of the skull, by means of branches that pass through apertures in the base of the cranium. Escaping from the plexus, the vein accompanies the artery to the parotid gland, and there joins the superficial temporal vein,—the union of the two giving rise to a vessel that enters either the external or the internal jugular vein (p. 31). Internal maxillary vein begins in plexus (pterygoid), and ends in external jugular.

The INFERIOR MAXILLARY NERVE is the largest of the three trunks arising from the Gasserian ganglion (p. 19), and resembles a spinal nerve in possessing fibrils that confer both motory and sensory properties on the parts to which they are distributed. The nerve leaves the skull by the foramen ovale in the sphenoid bone, and divides into two chief pieces beneath the external pterygoid muscle ; viz. an anterior, small, or muscular part ; and a large, posterior, or sensory part. Inferior maxillary nerve consists of a motor and sensory part.

Muscular
piece

A. The SMALLER PART receives nearly all the fibres of the motor root of the nerve, and ends in branches for the muscles of the jaw, viz. temporal, masseteric, and one pterygoid : and for one muscle of the cheek, the buccinator.

Directions.—Should the internal maxillary artery obstruct the view of the branches, it may be taken away.

supplies two
temporal
branches ;

1. The *deep temporal branches* are furnished to the under surface of the temporal muscle. Like the arteries, they are two in number, anterior and posterior. From their origin these nerves course upwards along the outer surface of the skull, and pass beneath the external pterygoid muscle.

posterior
and

The *posterior branch* is the smallest, and is often derived from the masseteric nerve ; it is near the back of the temporal fossa.

anterior.

The *anterior branch* supplies the greater part of the muscle, and communicates sometimes with the buccal nerve.

Masseteric.

2. The *masseteric branch* takes at first a backward course above the external pterygoid muscle, and then a horizontal one, behind the temporal muscle and through the sigmoid notch, to the under surface of the masseter muscle. In the masseter the nerve can be followed to near the anterior border. As this branch passes by the articulation of the jaw it gives one or more twigs to that joint.

Branches to
pterygoid
muscles.

3. The *pterygoid branches* are supplied to the muscles of that name, and come from both parts of the inferior maxillary nerve. The branch or branches to the *external pterygoid* arise from the small part, or from the buccal nerve, and enter its under surface. But the nerve to the *internal pterygoid* passes from the large part of the maxillary trunk beneath the upper border of its muscle, to the deep surface of which it is distributed ; it will be learnt in the dissection of the otic ganglion (SECTION 14).

Buccinator
nerve.

4. The *buccal branch* is longer than the others, and perforates the inner attachment of the external pterygoid ; afterwards it is directed inwards, beneath the coronoid process and the temporal muscle, to the surface of the buccinator, where it ends in two terminal branches. As the nerve perforates the pterygoid muscle filaments are given to the fleshy substance ; and after it has passed through the fibres it furnishes a branch to the temporal muscle, which frequently joins the anterior deep temporal nerve. Some offsets are distributed likewise to the upper part of the buccinator muscle and to the lining mucous membrane.

upper and

The *upper branch* resulting from the division reaches the

upper part of the buccinator muscle, and communicates with the facial nerve around the facial vein.

The *lower branch* is in direction the continuation of the lower nerve. Its offsets are inclined towards the angle of the mouth, supplying the integument, together with the buccinator muscle and the lining mucous membrane. This branch is united freely with the facial nerve, and forms a kind of plexus.

B. The **LARGER PART** of the inferior maxillary nerve ends in three trunks, auriculo-temporal, dental, and gustatory. A few of the fibres of the small (motor) root of the fifth are applied to this part, and are conveyed by it to certain muscles, viz. tensor tympani, circumflexus palati, internal pterygoid, and mylo-hyoideus and digastricus.

Sensory trunk of inferior maxillary. Conveys a few motor fibres.

The **AURICULO-TEMPORAL NERVE** separates from the others near the base of the skull, and has commonly two roots. Its course to the surface of the head is first backwards beneath the external pterygoid muscle, as far as the inner part of the articulation of the jaw; and lastly upwards with the temporal artery in front of the ear, and beneath the parotid gland. In this course the nerve furnishes branches to the surrounding parts, viz. to the joint, the ear, and the parotid gland, and communicates also with the facial nerve. Its ramifications on the head are described at page 7. In the part now dissected its branches are the following:—

Auriculo-temporal division

lies beneath jaw,

and supplies branches

a. *Branches for the meatus auditorius and the articulation.*—Two offsets are directed from the point of union of the branches of the facial with the auriculo-temporal nerve to the interior of the auditory meatus, entering it between the cartilage and bone. The branch to the articulation of the jaw is supplied from the trunk of the auriculo-temporal near the same spot, or from its branches to the meatus.

to the meatus and joint of jaw;

b. The *inferior auricular branch* supplies the external ear below the meatus auditorius. This branch also furnishes offsets along the internal maxillary artery, which communicate with the sympathetic nerve.

a branch the ear, and

c. *Parotid branches.*—These are small filaments that enter the substance of the gland.

parotid branches,

d. *Branches communicating with the facial and sympathetic nerves.*—Two or more branches around the external carotid artery connect the auriculo-temporal with the facial nerve; and filaments to the otic ganglion arise near its beginning.

to join facial and otic ganglion.

The **INFERIOR DENTAL** is the largest of the three trunks into which the inferior maxillary nerve divides, and is

Inferior dental

- is between pterygoid muscles, directed to the canal in the lower jaw. At first the nerve lies beneath the external pterygoid muscle, where it is external in position to the gustatory; and it is afterwards placed on the internal pterygoid, near the dental foramen, and on the internal lateral ligament. After the nerve enters the bone, it is continued forwards beneath the teeth to the foramen in the side of the jaw, and ends at that spot by dividing into an incisor, and a labial branch. Only one other muscular branch (mylo-hyoid) is supplied by the dental nerve. Its branches are :—
- then in the jaw, *a.* The *mylo-hyoid branch* arises from the trunk of the nerve as this is about to enter its foramen, and is continued along a groove on the inner aspect of the ramus of the jaw, to the cutaneous surface of the mylo-hyoideus and the anterior belly of the digastric muscle.
- and supplies also branch to mylo-hyoideus. *b.* The *dental branches* arise in the bone and supply the molar and bicuspid teeth. If the bone is soft, the canal containing the nerve and artery may be laid open so as to expose these branches.
- Dental branches to grinding teeth. *c.* The *incisor branch* continues the trunk of the nerve onwards to the middle line, and furnishes offsets to the canine and incisor teeth, beneath which it lies.
- and cutting teeth. *d.* The *labial branch* (mental?) issues on the face beneath the depressor of the angle of the mouth. At first it communicates with the facial nerve, and gives branches to the muscle covering it, as well as to the orbicularis and the integuments. But the greater part of the nerve is directed upwards beneath the depressor labii inferioris, and is distributed on the inner and outer surfaces of the lower lip.
- Branch to lower lip. The *inferior dental artery*, after entering the lower jaw with the nerve, has a similar course and distribution. Thus it supplies dental branches to the molar and bicuspid teeth, and ends anteriorly in an incisor and a labial branch.
- Dental artery has an incisor and labial branch. The *incisor branch* is continued to the symphysis of the jaw, beneath the canine and incisor teeth which it supplies, and anastomoses with the artery of the opposite side.
- Gustatory nerve courses to the tongue; The *labial branch*, after it has left the bone, ramifies in the structures covering the lower jaw, and communicates with the branches of the facial artery.
- The GUSTATORY or LINGUAL NERVE is the remaining trunk of the inferior maxillary, and is concealed at first, like the others, by the external pterygoid muscle. It is then inclined inwards over the internal pterygoid muscle, and under cover of the side of the jaw to the tongue. The remainder of



SUBMAXILLARY REGION.

99

this nerve will be seen in the dissection of the submaxillary region.

In this region the nerve does not distribute any branch to the parts around, but the following communicating branch (chorda tympani) is received by it. no branch here,

The *chorda tympani* is a branch of the facial nerve, and is distributed to the tongue. The origin of this nerve, and its course across the tympanum to its position beneath the external pterygoid, are described in SECTION 14. After issuing from the tympanum by an aperture near the Glas-serian fissure, this small nerve is applied to the gustatory nerve at an acute angle. At the point of junction some fibres communicate with the gustatory, but the greater part of the *chorda tympani* is conducted along that nerve to the lingualis muscle. An offset is furnished from it to the sub-maxillary ganglion : see the following Section. but is joined by chorda tympani.

SECTION VII.

SUBMAXILLARY REGION.

The term submaxillary region is applied to the part between the lower jaw and the hyoid bone. In it will be found small muscles acting on the os hyoides, the jaw, and the tongue ; the vessels and nerves of the tongue ; and the sublingual and submaxillary glands. Extent. Parts in it.

Position.—In this dissection the position of the neck is the same as the examination of the anterior triangle. Position of the head.

Dissection.—Directions for the cleaning of this region were given with the dissection of the anterior triangular space ; but if any fatty tissue has been left on the sub-maxillary gland, or on the mylo-hyoid muscle, let it be taken away. Dissection.

The *submaxillary gland* (fig. 10, ¹¹) lies below the jaw in the anterior part of the space limited by that bone and the digastric muscle. Its shape is irregular, and the facial artery winds over the surface. The gland rests on the mylo-hyoidens, and sends a process round the posterior or free border of that muscle. In front of it is the anterior belly of the digastric ; and behind it is the stylo-maxillary ligament separating it from the parotid. Occupying a position somewhat beneath the side of the jaw, the gland is very near the surface, being covered only by the integuments and platysma, and by the deep fascia. Situation and connections of submaxillary gland.

Structure. In structure, the submaxillary resembles the parotid gland (p. 31); and its duct—duct of Wharton, extends beneath the mylo-hyoid muscle to the mouth.

Dissection. *Dissection.*—The mylo-hyoid muscle may be seen by detaching the anterior belly of the digastric from the jaw, and by dislodging without injury the submaxillary gland from its position under the maxilla.

Mylo-hyoideus The MYLO-HYOID MUSCLE is triangular in shape, with the base at the jaw and the apex at the hyoid bone, and unites along the middle line with its fellow of the opposite side. It arises from the mylo-hyoid ridge on the inner surface of the lower jaw as far back as the last molar tooth, and is inserted into the middle of the body of the hyoid bone, as well as into a central tendinous band between the jaw and that bone. On the cutaneous surface are the digastric muscle, the submaxillary gland, the facial artery with the submental offset, and its own branch of nerve and artery. Its fibres are frequently deficient near the jaw, and allow the next muscle to be seen. Only the posterior border is unattached, and round it a piece of the submaxillary gland winds. The parts in contact with the deep surface of the muscle will be perceived after the following dissection has been made.

Parts around it.

Dissection, to detach mylo-hyoid.

Dissection.—To bring into view the muscles beneath the mylo-hyoid, and to trace the vessels and nerves to the substance of the tongue, the student should first divide the facial vessels on the jaw, and remove them with the superficial part of the submaxillary gland, but should be careful to leave the deep part of the gland that turns beneath the mylo-hyoideus. Next he should cut through the small branches of vessels and nerve on the surface of the mylo-hyoideus; and detaching that muscle from the jaw and its fellow, should throw it down to the os hyoides, but without injuring the genio-hyoid muscle beneath it.

To see deep muscles

Afterwards the soft parts covering the lower jaw are to be cut, and the bone is to be sawn through rather on the right side of the symphysis. The side of the jaw, which will then be loose (for the ramus of the bone has been previously sawn), is to be raised to see the parts beneath; but it should neither be taken away, nor be detached from the mucous membrane of the mouth. After the following dissection is completed, this loose piece of bone can be raised on the face out of the way.

The apex of the tongue is to be now drawn well out of the mouth over the upper teeth, and fastened with a stitch

to the septum of the nose; the scalpel should be then passed from below upwards between the sawn surfaces of the jaw, for the purpose of dividing a strong band of the mucous membrane of the mouth; and it should be carried onwards along the middle line of the tongue to the tip. After these directions have been followed the loose piece of the jaw can be easily turned upwards; and it is to be fastened in that position with thread.

By means of a hook the os hyoides may be drawn down, and the muscular fibres made tense. All the fat and areolar tissue are to be removed, and in doing this the student is to take care of the Whartonian duct; of the hypoglossal nerve and its branches that lie on the hyo-glossus muscle; also of the gustatory nerve, nearer the jaw, with its small ganglion close to the submaxillary gland. The student should endeavour to follow the small chorda tympani nerve, which is applied to the trunk of the gustatory, onwards to the tongue, and to define the offset from it to the submaxillary ganglion. The ranine vessels, and the gustatory and hypoglossal nerves are then to be found on the under part of the tongue, and to be followed to the tip.

Parts beneath mylo-hyoideus.—The following is the position of the objects brought into view by the steps of the previous dissection. Extending from the cornu of the hyoid bone to the side of the tongue is the hyo-glossus muscle, whose fibres are crossed superiorly by those of the stylo-glossus. On the hyo-glossus are placed, from below upwards, the hypoglossal nerve, the Whartonian duct, and the gustatory nerve, the latter crossing the duct; and near the inner border of that muscle the two nerves are united by branches. Beneath the same muscle is the lingual artery with its vein. Above the hyo-glossus is the mucous membrane of the mouth, with the sublingual gland attached to it in front, and some fibres of the superior constrictor muscle covering it behind near the jaw.

Between the chin and the os hyoides, along the middle line, is the genio-hyoid muscle; and larger and deeper than this is a fan-shaped muscle, the genio-hyo-glossus. Along the outer side of the last muscle lie the ranine vessels; and a sublingual branch for the gland of the same name springs from the lingual artery at the inner border of the hyo-glossus. On the under surface of the tongue, near the margin, lies the gustatory nerve; and in the fibres of the genio-hyo-glossus is the hypoglossal nerve.

The HYO-GLOSSUS MUSCLE is thin and somewhat square in

Parts beneath mylo-hyoid

on side of neck,

and along middle line.

Hyo-glossus

- shape. The muscle *arises* from the lateral part of the body of the os hyoides (basio-glossus), from all the great cornu of the same bone (cerato-glossus), and separately from the small cornu (chondro-glossus). The two first parts form a thin sheet, and enter the back part and side of the tongue; they will be seen afterwards to mingle with fibres of the palato- and stylo-glossus.* The parts in contact with one surface of the hyo-glossus have been already enumerated; and those beneath the muscle are portions of both the genio-hyo-glossus, and the middle constrictor, together with the lingual vessels. Along the anterior border is the genio-hyo-glossus muscle; and beneath the posterior pass the lingual artery, the glosso-pharyngeal nerve, and the stylo-hyoid ligament.
- named from attachment; Stylo-glossus
- in contact with many parts.
- comes to side of tongue.
- The STYLO-GLOSSUS is a slender muscle, whose attachments are expressed by its name. Arising from the styloid process near the apex, and from the stylo-maxillary ligament, the muscle is continued forwards to the side of the tongue. Here it gives fibres to the dorsum, and crossing the preceding turns to the under surface, and extends to the tip of the tongue. Beneath the jaw this muscle is crossed by the gustatory nerve.
- Genio-hyoideus
- along middle line of neck.
- The GENIO-HYOID MUSCLE *arises* from the lower of the two lateral tubercles on the inner aspect of the symphysis of the jaw, and is *inserted* into the middle of the hyoid bone. Covered by the mylo-hyoideus, this muscle rests on the genio-hyo-glossus. The inner border is close to its fellow of the opposite side, and the two are often united.
- Genio-hyo-glossus
- connected with chin, hyoid bone, and tongue.
- Contiguous parts.
- The GENIO-HYO-GLOSSUS is the largest muscle of this region; it has a triangular form, the apex being at the jaw, and the base at the middle line of the tongue. It takes *origin* from the upper tubercle behind the symphysis of the jaw. From this spot the fibres radiate, the posterior passing downwards to their insertion into the body of the hyoid bone, the anterior forwards to the tip of the tongue, and the intermediate to the whole length of the tongue from root to point. Lying along the middle of the tongue, it is in contact with its fellow; whilst the lower border of the muscle corresponds with the genio-hyoideus, and the upper with the frænum linguae. On its outer side are the ranine vessels, and the hyo-glossus muscle; and the hypoglossal nerve perforates the posterior fibres.

* The third part (chondro-glossus) is distinct from the others, and ends on the upper surface of the tongue near the root; but for further details respecting the anatomy of this and the other lingual muscles, reference is to be made to the dissection of the tongue, SECTION 15.

The *lingual artery* is one of the anterior branches of the external carotid, and arises between the superior thyroid and facial branches. At first it is directed inwards above the os hyoides, but is afterwards inclined slightly upwards beneath the hyo-glossus to the under part of the tongue, and ends at the anterior border of that muscle in the sublingual and ranine branches. Before reaching the hyo-glossus the artery is comparatively superficial, though it is crossed near that muscle by the ninth nerve, and by the digastric and stylo-hyoid muscles. Beneath the hyo-glossus, the vessel rests on the middle constrictor and genio-hyo-glossus muscles, and is situate below the level of the glosso-pharyngeal nerve. Its branches are these:—

a. A small *hyoid branch* is distributed on the upper border of the os hyoides, where it anastomoses with the one of the opposite side, and with the hyoid branch of the superior thyroid artery.

b. A branch to the *dorsum of the tongue* arises beneath the hyo-glossus muscle, and ascends to supply the substance of that organ. The fibres of the hyo-glossus must be divided to see it.

c. The *sublingual branch* springs from the final division of the artery at the edge of the hyo-glossus, and is then directed outwards to the gland from which it takes its name. Some offsets supply the gums and the mylo-hyoid muscle, and one continues behind the incisor teeth to join a similar artery from the other side.

d. The *ranine branch* is the terminal part of the lingual artery, and extends forwards along the outer side of the genio-hyo-glossus to the tip of the tongue where it ends: it anastomoses with the artery of the other side of the body. Muscular offsets are furnished to the substance of the tongue. This artery lies along the frænum linguæ near the tip of the tongue, but is close to the muscular fibres.

The *lingual vein* commences on both the upper and under surfaces of the tongue. It lies with its companion artery, and ends in the internal jugular vein.

The GUSTATORY OR LINGUAL NERVE has been followed in the examination of the pterygo-maxillary region to its passage between the ramus of the lower jaw and the internal pterygoid muscle. In this dissection the nerve is seen to be inclined forwards to the side of the tongue, over the mucous membrane of the mouth and the origin of the superior constrictor muscle, and above the deep part of the submaxillary gland. Lastly, the nerve is directed across

Lingual
artery

ascends to
the tongue
beneath
hyo-glossus.

Its branches
are—

to hyoid
bone;

to back of
the tongue;

to the sub-
lingual
gland;

to the sub-
stance of
tongue.

Ranine is
along fræ-
num.

Lingual
vein.

Lingual
nerve

along side of
tongue

- the Whartonian duct, and along the side to the apex of the tongue. In this region the gustatory nerve is separated altogether from the cavity of the mouth by the mucous membrane. *Branches* are furnished to the surrounding parts, thus :—
- gives branches to the ganglion, to ninth nerve, to mucous membrane, to the papillæ. Submaxillary ganglion ; nature ; joins gustatory, facial, and sympathetic nerves. Branches. Ninth nerve, between the chin and hyoid bone, is lost in
- a. Two or more branches connect it with the submaxillary ganglion, near the gland of that name.
- b. Farther forwards branches descend on the hyo-glossus to unite in a kind of plexus with twigs of the hypoglossal nerve.
- c. Other filaments are supplied to the mucous membrane of the mouth and the gums, and to the sublingual gland.
- d. Lastly the *branches for the tongue* ascend through the muscular substance, and are distributed as well to the conical and fungiform papillæ.
- Submaxillary ganglion.*—Closely connected with the gustatory nerve is this little ganglion, which resembles the other ganglia connected with the three trunks of the fifth nerve, since it communicates with sensory, motory, and sympathetic nerves. It is a small reddish body, less in size than the lenticular ganglion, and is placed above the deep process of the submaxillary gland. Offsets proceed upwards to connect it with other nerves, and from the lower part arise the branches that are distributed to the adjacent structures.
- Connection with nerves—roots.*—Two or three branches, in the form of loops, pass from the ganglion to the gustatory nerve. At the posterior part, the ganglion is further joined by an offset from the chorda tympani (of the facial nerve) which lies in contact with the gustatory. And its sympathetic branch comes from the nerves around the facial artery.
- Branches.*—From the lower part of the ganglion five or six branches descend to the substance of the submaxillary gland ; and from the anterior part other filaments are furnished to the mucous membrane of the mouth and to the Whartonian duct.
- The HYPO-GLOSSAL OR NINTH NERVE, after crossing the side of the neck and the anterior triangle (p. 82), enters between the small muscles of the submaxillary region. Here the nerve lies on the hyo-glossus muscle, being concealed by the mylo-hyoideus : but at the inner border of the hyo-glossus it enters the fibres of the genio-hyo-glossus, and is continued along the middle line of the tongue to the apex. The position of the ninth nerve is in the centre of

the tongue, whilst the gustatory lies near the margin : the ninth supplies branches to the muscular structure, and the gustatory ends chiefly in the papillæ. middle of tongue.

Branches.—On the hyo-glossus the ninth nerve furnishes branches to the muscles of the submaxillary region, except the mylo-hyoid and the digastric, viz., to the hyo-glossus, stylo-glossus, genio-hyoideus, and genio-hyo-glossus. Further, some offsets ascend on the hyo-glossus to communicate with the gustatory nerve. Along the middle of the tongue the nerve sends upwards long filaments with the branches of the ranine artery, which supply the structure of the tongue, and communicate with the gustatory nerve. Its branches supply muscles and the tongue.

The *duct of the submaxillary gland*, or Wharton's duct, issues from the deep part of the glandular mass that turns round the border of the mylo-hyoid muscle. It is about two inches in length, and is directed upwards on the hyo-glossus muscle, and beneath the gustatory nerve, to open on the side of the frænum linguæ in the centre of an eminence. The duct consists of three coats,—an external thin and fibrous, a middle or muscular, and an internal or mucous with cylindrical epithelium ; and its opening in the mouth will be seen if a bristle be passed along it. The deep part of the submaxillary gland extends, in some instances, even to the sublingual gland. Wharton's duct opens by frænum linguæ. Structure.

The *sublingual gland* is somewhat of the shape of an almond, and the longest measurement, which is about one inch and a half, is directed backwards. It is situated beneath the anterior part of the tongue, in contact with the inner surface of the lower jaw, close to the symphysis. Separated from the cavity of the mouth by the mucous membrane, the gland is prolonged across the upper border of the genio-hyo-glossus muscle, so as to touch the one of the opposite side. Sublingual gland is beneath tongue.

The sublingual resembles the other salivary glands in its composition (p. 31). The ducts of the lobules (ductus Riviniani) are from eight to twenty in number, of which some open beneath the tongue along a crescentic-shaped fold of the mucous membrane ; others join the Whartonian duct ; and one or more form a larger tube, which either joins that duct or opens near it. Structure. Ducts open in mouth.

SECTION VIII.

SUPERIOR MAXILLARY NERVE AND VESSELS.

Superior
maxillary
nerve next.

Directions.—The student may examine next the remaining trunk of the fifth nerve, viz. the superior maxillary, as this can be seen most conveniently after the dissection of the pterygo-maxillary and submaxillary regions has been made.

Dissection.

Dissection.—The superior maxillary division of the fifth nerve, in its course to the face, occupies successively the skull, the spheno-maxillary fossa, and the infraorbital canal; and to lay bare the nerve in its whole extent the skull, the above mentioned fossa, and the orbit must be opened. The skull and the orbit will have been opened already, if the preceding instructions have been followed; but if the latter has not been dissected, refer to the necessary steps (p. 41).

In spheno-
maxillary
fossa.

To trace the nerve in the spheno-maxillary fossa, the student may make the following dissection:—The middle fossa of the base of the skull is to be cut through from the inside with a chisel; the cut is to be made from the sphenoidal fissure in front to the foramen spinosum behind, and external to the foramen rotundum and foramen ovale. The side of the skull is then to be sawn through vertically in front of the petrous part of the temporal bone, so that the incision shall end at the posterior extremity of the cut made in the base with the chisel. Afterwards, with a bone forceps or a saw the outer wall of the orbit is to be divided into the spheno-maxillary fissure. The piece of bone forming part of both the skull and orbit is now loose, and is to be removed with the temporal muscle. The nerve can be partly seen as it crosses the spheno-maxillary fossa: but to bring it more completely into view, some of the sphenoid bone bounding the fossa must be taken away, so as to leave only an osseous ring round the nerve at its exit from the skull. In the fat of the fossa the student is to seek the following offsets,—the orbital branch, branches to Meckel's ganglion, and dental branches to the upper jaw.

In floor of
the orbit.

To follow onwards the nerve in the floor of the orbit, the contents of the cavity must be taken away, and the bony canal in which it lies must be opened to the face. Near the front of the orbit the anterior dental branch is to be traced downwards for some distance in the bone. The infraorbital vessels are to be prepared with the nerve.

The SUPERIOR MAXILLARY NERVE commences in the Gasserian ganglion (p. 19), and leaves the cranium by the foramen rotundum. The course of the nerve is then almost straight to the face, along the orbital plate of the superior maxilla. Outside the cranium the nerve is placed first across the sphenomaxillary fossa, and it enters afterwards the infraorbital canal. Issuing from the canal by the infraorbital foramen, the nerve is concealed by the elevator of the upper lip, and ends in branches to the eyelid, nose, and upper lip. It furnishes the following branches :—

Upper maxillary nerve passes to face, through infraorbital canal, where it ends.

1. The *orbital branch* arises in the sphenomaxillary fossa, and enters the orbit through the fissure of the same name ; it divides into a malar and a temporal branch (see p. 51).

Its branches are to orbit ;

2. The *sphenopalatine branches* descend from the nerve in the fossa, and supply the nose and palate ; these are connected with Meckel's ganglion, and will be dissected with it.

to the nose and palate ;

3. Two *posterior dental branches* leave the trunk of the nerve near the upper jaw. One is distributed to the gums and the buccinator muscle. The other enters a canal in the upper maxilla, and supplies branches to the molar teeth and the lining membrane of the antrum ; it joins the anterior dental branch soon after entering the bone, and again near the teeth.

to the teeth and buccinator ;

4. The *anterior dental branch* quits the trunk of the nerve in the floor of the orbit, and descends to the anterior teeth in a special canal in front of the antrum. It is distributed by two branches. One (the inner) gives filaments to the incisor and canine teeth, and furnishes, moreover, one or two filaments to the lower meatus of the nose ; the other (outer) ends by supplying the bicuspid teeth.

to anterior teeth.

5. Before the nerve ends in the facial branches, it supplies a small *palpebral branch* to the lower eyelid ; this is directed upwards to the lid in a groove in the margin of the orbit.

Branch of eyelid.

6. *Infraorbital or facial branches*.—These are larger than the other offsets of the nerve, and form its terminal ramifications. Some incline inwards to the side of the nose, and the rest descend to the upper lip. These branches are crossed near the orbit by branches of the facial nerve, with which they communicate, the whole forming the *infraorbital plexus* (p. 40).

Infraorbital branches,

a. The branches to the side of the nose supply the muscular and tegumentary structures.

join facial nerve, and supply the

b. The branches to the upper lip are three or four in

and upper lip.

number, and are distributed chiefly to the surfaces of the lip, though they supply as well the labial glands and the muscles.

Infraorbital artery The *infraorbital artery* is one of the terminal branches of the internal maxillary artery in the sphenomaxillary fossa, and accompanies the superior maxillary nerve. Taking the course of the nerve through the infraorbital canal, the vessel appears in the face beneath the elevator muscle of the upper lip; and ends in branches, which are distributed, like those of the nerve, to the parts between the eye and mouth. In the face its branches anastomose with the facial and buccal arteries.

ends in face; *a.* In the canal in the upper maxilla this artery furnishes branches to the orbit.

has a branch to orbit, *b.* Another branch, *anterior dental*, runs with the nerve of the same name, and supplies the incisor and canine teeth. This gives offsets to the antrum of the maxilla, and near the teeth it anastomoses with the posterior dental artery.

and one to anterior teeth. The *vein*, accompanying the artery, communicates in front with the facial vein; and behind, with a plexus of veins corresponding with the offsets of the internal maxillary artery in the sphenomaxillary fossa.

Infraorbital vein.

SECTION IX.

DEEP VESSELS AND NERVES OF THE NECK.

Parts in this section. In this Section are included the deepest styloid muscle, the internal carotid and ascending pharyngeal arteries, and the eighth, ninth, and sympathetic nerves.

Position. *Position.*—The position of the part is to remain as before, viz. the neck is to be fixed over a small block.

Dissection of the stylopharyngeus. *Dissection.*—To see the remaining styloid muscle, the posterior belly of the digastric, and the stylohyoid muscle should be detached from their origin and thrown down. At this stage, a filament of the facial nerve may be sometimes seen to perforate the digastric muscle, and join the glossopharyngeal nerve beneath. The trunk of the external carotid artery is to be removed by cutting it through where the hypoglossal nerve crosses it, and by dividing those branches that have been already examined, as well as, if it is necessary, the veins accompanying the arteries. In cleaning the surface of the stylopharyngeus muscle, the glossopharyngeal nerve.

Glossopharyngeal nerve.

ryngeal nerve and its branches may be prepared. The side of the jaw is still to be drawn upwards and forwards, as in the dissection of the submaxillary region.

The **STYLO-PHARYNGEUS MUSCLE** resembles the other styloid muscles in its elongated form. The fibres arise from the root of the styloid process on the inner surface, and descend between the superior and middle constrictors to be inserted partly into the pharynx, and partly into the upper border (hinder border, Merkel*) of the thyroid cartilage. The muscle lies below the stylo-glossus, and between the carotid arteries; and the glosso-pharyngeal nerve turns over the lower part of its fleshy belly.

Stylo-pharyngeus.
Origin.

Insertion.

Is between carotid arteries.

The *stylo-hyoid ligament* is a fibrous band, which extends from the tip of the styloid process to the small cornu of the os hyoides. Its position is between the stylo-glossus and stylo-pharyngeus muscles, and over the internal carotid artery, whilst the lower end is beneath the hyo-glossus muscle. To the posterior border the middle constrictor muscle is attached. It is frequently cartilaginous or osseous in part of, or in all its extent. Occasionally a slip of fleshy fibres is continued along it.

Stylo-hyoid ligament

lies by side of preceding.

The **INTERNAL CAROTID ARTERY** supplies parts within the head, viz. the brain, and the eye with its appendages; and takes a circuitous course through, and along the base of the skull before it terminates in the brain.

Internal carotid artery.

The part of the arterial trunk in the base of the skull, and its offset to the orbit, have been already examined; but the parts in the neck and the temporal bone remain to be dissected. The branches of the carotid to the brain are described with the encephalon.

Some parts already seen.

Dissection.—For the display of the cervical part of the artery there is now but little dissection required, since by detaching the styloid process at the root, and throwing it with its attached muscles to the middle line, the internal carotid artery and the jugular vein may be followed upwards to the skull. Only a dense fascia now conceals them, which is to be taken away carefully, so that the branches of the eighth and ninth nerves in contact with the vessels near the base of the skull may not be injured. In the fascia, and directed inwards over the artery near the skull, are the pharyngeal branch of the vagus, and the glosso-pharyngeal nerve and its branches; whilst the superior laryngeal branch

Dissection of carotid in the neck;

* Anatomie und Physiologie des Menschlichen Stimm und Sprach Organs. Leipzig, 1857. Von Dr. Merkel.

of the vagus crosses beneath the carotid. Between the vein and artery, near the skull, are the vagus, hypoglossal, and sympathetic nerves; and crossing backwards, over or under the vein, the spinal accessory nerve. External to the position of the vessels will be found a loop of the first and second cervical nerves, over the transverse process of the atlas, which communicates with the large ganglion of the sympathetic beneath the artery, and with the eighth and ninth nerves. Ascending to the cranium, on the inner side of the carotid, is the ascending pharyngeal artery.

in the tem-
poral bone.

To open the carotid canal in the temporal bone, and to follow the contained artery into the cranium, make a cut down the side of the skull in the following manner:—the saw being placed behind and below the mastoid process, cut forwards obliquely to the foramen spinosum in the wing of the sphenoid bone (to which spot the side of the skull has been already taken away), and let the instrument be directed through the stylo-mastoid foramen and the root of the styloid process, but rather external to the jugular foramen and the carotid canal. When the piece of detached bone has been taken away, the carotid canal may be opened with the bone forceps. In dissecting the artery in the canal, large and rather red branches of the superior cervical ganglion of the sympathetic will be found on it; and with care and a fresh part two small filaments may be recognised,—one from Jacobson's nerve, joining the sympathetic at the posterior part of the canal; the other from the vidian nerve, at the front of the canal.

Piece of
tympanum
obtained.

On the piece of bone that has been cut off, the dissector may prepare very readily the tympanum with its membrane, the chain of bones, and the chorda tympani nerve.

Internal
carotid
enters the
skull.

The *internal carotid artery* springs from the bifurcation of the common carotid trunk. It extends from the upper border of the thyroid cartilage to the base of the skull; then through the petrous portion of the temporal bone; and lastly along the base of the skull to the anterior clinoid process, where it ends in branches for the brain. This winding course of the artery may be divided into three parts:—one part in the neck, another in the temporal bone, and a third in the cranium.

Its course is
first

through the
neck

Cervical part.—In the neck the artery ascends almost vertically from its origin to the carotid canal, and is in contact with the pharynx on the inner side. Its depth from the surface varies like that of the external carotid; and the line of the digastric muscle may be taken as the index of

this difference. Thus, below that muscle, the internal carotid is contained in the anterior triangular space, being overlapped by the sterno-mastoid, and covered by the common teguments, fascia, and platysma, and is on the same level as the external carotid, though farther back. But, above that muscle, the vessel is placed deeply beneath the external carotid artery and the parotid gland, and is crossed by the styloid process and the stylo-pharyngeus muscle, by the glosso-pharyngeal nerve and its branches, and by the pharyngeal branch of the vagus nerve. Whilst in the neck the internal carotid lies on the rectus capitis anticus major muscle, which separates it from the vertebræ, also on the superior laryngeal and sympathetic nerves. Accompanying the artery is the internal jugular vein, which is placed on the outer side; and between the two vessels and parallel to them is the pneumo-gastric nerve. This part of the artery remains much the same in size to the end, and usually does not furnish any branch.

where it is superficial below,

but deep above;

resting on longus colli,

with internal jugular vein and vagus.

Part in the temporal bone.—In the carotid canal the tortuous course of the vessel commences. Following the winding of its canal, the artery first ascends in front of the inner ear (cochlea and tympanum); next it is directed forwards almost horizontally; and lastly it turns upwards into the cranium opposite the foramen lacerum (basis cranii). Branches of the sympathetic nerve surround the carotid in the temporal bone.

Second part in temporal bone.

Whilst in the temporal bone the artery supplies a small branch to the cavity of the tympanum.

Offset to the tympanum.

The cranial part of the artery is described with the base of the skull (see p. 21).

Third part.

Peculiarities in the carotid.—The length of the internal carotid vessel varies in a given number of bodies, both from difference in the length of the neck, and in the point of division of the common carotid trunk. The course of the vessel may be very tortuous, instead of being straight.

Peculiarities in length.

It has been already said (p. 81), that the internal carotid may arise sometimes from the arch of the aorta.

Further, this vessel may be absent from the neck: in such case the common carotid may take its place, and give the usual offsets of the external carotid. In one instance (Quain) where the artery was deficient in the neck, two branches of the internal maxillary entered the skull, and formed by their union a substitute for it in the cranium.

Absence.

The INTERNAL JUGULAR VEIN is continuous with the lateral sinus of the skull, and extends from the foramen jugulare to the sterno-clavicular articulation. At the lower

Internal jugular vein joins in-

feriorly sub-clavian. part of the neck it has been seen to join the subclavian, to form the innominate vein (p. 80).

As far as the thyroid cartilage this vein accompanies the internal carotid, but below that point it is with the common carotid artery; and it lies on the outer side of each. Its contiguity to the artery is not equally close in all its extent, for near the skull there is a small interval between them, containing the eighth and ninth nerves; and at the lower part of the neck there is a still larger intervening space, in which the pneumogastric nerve is found. The size of the upper part of the vein remains much the same till near the os hyoides, where it is suddenly increased by the addition of those branches of the head and neck, corresponding with branches of the external carotid artery, which do not join the external jugular vein. Its lower dilatation and its valves have been before referred to, p. 80.

Size.

It is joined by branches below os hyoides.

The following branches open into the internal jugular, viz. the facial, lingual, thyroid (superior), occipital, and pharyngeal; and at the lower part of the neck it receives the middle thyroid vein.

Different names.

Sometimes the term *internal cephalic* is applied to the vein between the skull and the hyoid bone; whilst the name *internal jugular* is given to the part below that bone and the junction of its large branches.

Ascending pharyngeal artery

The *ascending pharyngeal artery* is a long slender branch of the external carotid, which arises near the commencement of that vessel. Directed upwards on the spinal column between the internal carotid and the pharynx, the artery becomes tortuous near the skull, and divides into branches for the pharynx and the cranium. In the neck the artery gives some small offsets to the surrounding parts, viz. the muscles on the vertebræ, the nerves, and the lymphatic glands; and other branches anastomose with the ascending cervical artery.

ends near skull, in

a branch to meninges,

a. The *meningeal branch* enters the cranium through the foramen lacerum (basis cranii), and is distributed on the meninges of the middle fossa of the skull.

and another to pharynx and palate.

b. The *pharyngeal branch*, which is larger than the preceding, turns inwards to the pharynx, and dividing into several twigs, supplies the muscular structure of the pharynx, the soft palate, and the Eustachian tube. The size of the *palatine branch* depends upon that of the inferior palatine branch of the facial artery; it courses above the upper constrictor, and ends in branches that are distributed on the front and back of the soft palate, beneath the mucous membrane.

The vein accompanying the pharyngeal artery receives its vein, branches from the cranium and the pharynx, and ends in the internal jugular vein.

Dissection of the eighth nerve.—By the time the student has arrived at this stage of the dissection, it will not be possible for him to trace the very minute filaments of the eighth nerve in the foramen jugulare of the skull. The student is recommended therefore to omit, for the present, all the paragraphs marked with an asterisk. Afterwards, if a fresh piece of the skull can be obtained, in which the nerves have been hardened by spirit, and the bone softened by acid, he may return to the examination of the parts that are now passed over.

Directions
concerning
eighth
nerve.

* *In the foramen lacerum.*—Supposing the dissection of the internal carotid to be made as it is described at page 110, let the student cut across with care the jugular vein near the skull, and the internal carotid, if it is necessary. Let him then remove, bit by bit, with the bone forceps, or with a scalpel if the part has been softened, the ring of bone that bounds externally the jugular foramen, proceeding as far forwards as the crest of bone between the foramen and the aperture of the carotid canal. Between the ring of bone and the coat of the jugular vein, is the small auricular branch of the pneumo-gastric nerve, which is directed backwards to an aperture near the styloid process.

Dissection
to open
jugular
foramen.

* First trace the pneumo-gastric and spinal accessory nerves through the canal, by opening the fibrous sheath that surrounds them. On the pneumo-gastric is a small ganglion, from which filaments are to be sought passing to the smaller portion of the spinal accessory nerve, and to the ascending branch of the upper cervical ganglion of the sympathetic; the auricular branch, before referred to, also takes origin from this ganglion. Two parts, large and small, of the spinal accessory nerve should be defined: the latter is to be shown joining the ganglion of the vagus, and then applying itself to the trunk of that nerve. A communication also exists between the two parts of the spinal accessory.

Follow
pneumo-
gastric and
spinal acces-
sory and
their
branches;

* Next follow the glosso-pharyngeal nerve through the foramen, and take away any bone that overhangs it. This nerve presents two ganglia as it passes from the skull: one (jugular), which is scarcely to be perceived, near the upper part of the tube of membrane that contains it; the other, much larger (petrous), is placed at the lower border of the petrous portion of the temporal bone. From the lower one, seek a filament of communication with the sympathetic in

afterwards
glosso-phar-
yngcal

and its
branches.

the neck ; also Jacobson's nerve, which enters an aperture in, or on one side of the crest of bone between the jugular foramen and the carotid canal. Sometimes there will exist a filament from the lower ganglion to join the auricular branch of the pneumo-gastric, and another to end in the upper ganglion of the pneumo-gastric nerve.

Dissection
of the
nerves in
the neck.

Below the foramen of exit from the skull, the eighth nerve has been sufficiently denuded by the dissection of the internal carotid to examine all its branches in the neck, with the exception of the inferior laryngeal nerve. But the connections between the eighth, ninth, sympathetic, and first two spinal nerves should be traced out more completely near the skull. Taking the pneumo-gastric nerve, it will be found to swell* into a large oval body (lower ganglion), which is closely united with the hypoglossal, and is connected by branches with the other nerves. The hypoglossal nerve communicates also with the sympathetic and the spinal nerves. Lastly the student should trace the recurrent branch of the vagus from the lower part of the neck to the larynx.

Eighth
nerve

The EIGHTH CRANIAL NERVE consists of three distinct trunks, viz. glosso-pharyngeal, pneumo-gastric, and spinal accessory (Willis), which leaves the cranium by the foramen jugulare (p. 20). Outside the skull these nerves take different directions according to their destination ; thus the glosso-pharyngeal is inclined inwards to the tongue and pharynx ; the spinal accessory passes backwards to the sterno-mastoid and trapezius muscles ; and the pneumo-gastric nerve descends to the viscera of the thorax and abdomen.

consists of
the three
following
trunks :

Glosso-pharyngeal
nerve ;

The GLOSSO-PHARYNGEAL NERVE (fig. 14, ¹) is the smallest of the three trunks, and in the jugular foramen it is placed somewhat in front of the other two ; it lies in a groove in the lower border of the petrous part of the temporal bone. In the aperture of exit the nerve is marked by two ganglionic swellings, the upper one being the jugular, the lower one the petrous ganglion.

has two
ganglia in
foramen
lacerum.

Its upper

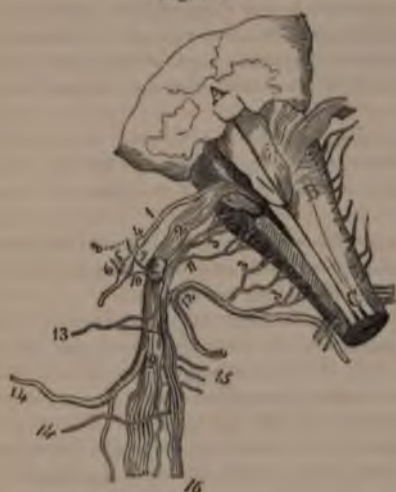
Ganglia.—The *jugular ganglion*, 4, (gang. superius) is of very small size, and is situated at the upper part of the osseous groove that contains the nerve. It is placed at the distal aspect of the glosso-pharyngeal trunk, and includes some fibrils of the nerve. The *petrosal ganglion*, 5, (gang. inferius), is much larger than the preceding, and encloses the fibrils of the nerve. This ganglion is placed in a

and lower
ganglion.

in the lower border of the temporal bone, and from it arise the branches that unite the glosso-pharyngeal with the other nerves.

After the nerve has quitted the foramen, it comes in the neck forwards between the jugular vein and the carotid artery,

Fig. 14.*



and crossing inwards over the artery, reaches the lower border of the stylo-pharyngeus muscle. At this spot the nerve becomes almost transverse in direction in its course to the pharynx; it passes over the stylo-pharyngeus, and forms an arch across the side of the neck (p. 66), above the superior laryngeal nerve. Finally the nerve enters beneath the hyoglossus muscle, and ends in branches to the pharynx, the tongue, and the tonsil.

The branches of the glosso-pharyngeal may be classed into those connecting it with other nerves at the base of the skull, and into those that are distributed in the neck.

* Diagram (Benda) of the eighth nerve. 1. Glosso-pharyngeal trunk. 2. Vagus. 3. Spinal accessory. 4. Jugular ganglion. 5. Petrosal ganglion. 6. Jacobson's nerve. 7. Root ganglion of vagus. 8. Its auricular branch. 9. Trunk ganglion of vagus. 10. Branch joining the petrosal and upper ganglion of the vagus. 11. Small part of spinal accessory. 12. Chief part of spinal accessory. 13. Pharyngeal branch of vagus. 14. Superior laryngeal branch of vagus.

- with others, viz. *Connecting branches.*—These arise chiefly from the petrosal ganglion, and in this set is the tympanic nerve.
- sympathetic and vagus, 1. *A *filament* ascends from the *sympathetic nerve* in the neck to join the petrosal ganglion. Sometimes there is a filament given from the ganglion to the auricular branch of the vagus, as well as to the upper ganglion of that nerve.
- facial and sympathetic by this branch, 2. *The *tympanic branch* (fig. 14, ⁶) (nerve of Jacobson) enters the aperture in the ridge of bone between the jugular and the carotid foramen, and ascends by a special canal to the inner wall of the tympanum, where it ends in branches. Its distribution is given with the anatomy of the tympanum of the ear.
- and with facial; 3. *Connecting branch of the facial nerve.*—This pierces the digastric muscle, and joins the trunk of the glossopharyngeal, below the petrosal ganglion: it is not always present.
- distributed to *Branches for Distribution.*—In the neck the branches are furnished chiefly to the tongue and the pharynx, but they are also united with other nerves.
- carotid artery, 1. *Carotid branches* surround the artery of that name, and communicate on it with the pharyngeal branch of the vagus, and with the sympathetic nerve.
- stylo-pharyngeus, 2. Some *muscular branches* enter the stylo-pharyngeus, whilst the nerve is in contact with it.
- and pharyngeal plexus, 3. *Branches to the pharynx* form the pharyngeal plexus by uniting with nerves from the sympathetic and vagus.
- the tonsil, 4. The *tonsillitic branches* supply the tonsil and the arches of the soft palate. On the former they end in a kind of plexus—*circulus tonsillaris*.
- and the tongue. 5. *Lingual branches.*—The terminal branches of the nerve supply the root and the posterior part of the tongue, as well as the lateral surface. The distribution of these is described with the tongue (SECTION 15).
- Vagus nerve The PNEUMO-GASTRIC NERVE (fig. 14, ⁵) (vagus nerve) is the largest of the three trunks of the eighth cranial nerve (Willis), and occupies the same sheath of dura mater as the spinal accessory in the jugular foramen. In the foramen it has a distinct ganglion (gang. of the root), to which the smaller part of the spinal accessory nerve is connected.
- in foramen jugulare, When the nerve has escaped from the foramen, it receives the small part of the spinal accessory, and swells into a large ganglion (gang. of the trunk). Here the nerve lies between the carotid artery and the jugular vein, and communicates with the several nerves at this part. To reach the thorax, the vagus descends almost vertically
- and in the neck,

between the internal jugular vein and the internal and common carotid arteries, and enters that cavity, on the right side, by crossing over the subclavian artery. courses to the thorax.

Ganglia.—The *ganglion of the root* (gang. superius), 7, is of a greyish colour, and in texture is like the ganglion on the large root of the fifth nerve. The small branches of the vagus in the foramen jugulare come from this ganglion. The *ganglion of the trunk* (gang. inferius), 9, is cylindrical in form, is reddish in colour, and is nearly an inch in length. It communicates with the hypoglossal, spinal, and sympathetic nerves. All the intrinsic fibres of the trunk of the nerve are surrounded by the ganglionic substance, but those derived from the spinal accessory nerve, 16, pass by the ganglion without being inclosed in it. One ganglion in foramen, another below.

The same arrangement may be made of the *branches* of the pneumo-gastric in the neck, as was adopted for the branches of the glosso-pharyngeal, viz. into those uniting it with other nerves, and those that are distributed to the parts around. Branches

Connecting Branches.—Branches of communication arise from both the ganglion of the root and the ganglion of the trunk of the nerve. to unite with others ;

**a. From the ganglion of the root.*—One or two short filaments unite this ganglion with the spinal accessory nerve, and a branch of the sympathetic nerve in the neck enters the ganglion. Occasionally there is an offset, 10, to join the lower (petrosal) ganglion of the glosso-pharyngeal nerve. Its chief branch is the following :— spinal accessory, sympathetic, glosso-pharyngeal ;

*The *auricular branch*, 8, traverses the substance of the temporal bone, and reaches the outer ear, on which it is distributed. This little nerve arises from the ganglion, and crosses the jugular fossa to enter an aperture near the root of the styloid process. Its farther course to the outer ear will be described with the anatomy of the ear. auricular branch ;

**b. From the ganglion of the trunk.*—This ganglion is connected intimately with the hypo-glossal nerve. Other branches pass between it and the upper ganglion of the sympathetic, 15, and between it and the loop of the first two cervical nerves. with ninth, sympathetic, spinal nerves.

Branches for Distribution.—These cervical branches arise from the inner side of the nerve, and are directed to the middle line of the body, to supply the pharynx, the larynx, and the heart. Branches to supply

1. The *pharyngeal branch*, 13, is an offset from the upper part of the ganglion of the trunk of the pneumo-gastric, and pharynx

and join
glosso-
pharyngeal

and pharyn-
geal plexus.

terminates, as the name expresses, in the pharynx. The nerve is directed inwards over the internal carotid artery, and joins the branches of the glosso-pharyngeal nerve on that vessel. Finally it courses to the side of the middle constrictor muscle, and communicates with branches of the glosso-pharyngeal, superior laryngeal, and sympathetic nerves, to form the *pharyngeal plexus* of the same side. This plexus is opposite the middle constrictor, and branches are furnished by it to the muscles, and to the pharyngeal mucous membrane between the tongue and the hyoid bone.

To enter
larynx,

and supply
it and

2. The *superior laryngeal nerve*, 14, is much larger than the preceding branch, and arises from the middle of the ganglion of the trunk of the vagus. From this spot the nerve inclines obliquely inwards beneath the internal carotid artery, and reaches the larynx opposite the interval between the hyoid bone and the thyroid cartilage. The nerve then perforates the thyro-hyoid membrane, and is distributed to the mucous membrane of the larynx. (See "LARYNX.") In the neck it furnishes branches to the thyroid body, and the following offset to one laryngeal muscle and the pharynx.

a branch
outside
larynx

to cricothy-
roid and
pharynx.

a. The *external laryngeal branch* arises in the neck beneath the internal carotid artery. Taking a course similar to that of the superior laryngeal nerve, but below it, this branch reaches the side of the larynx, and gives offsets to the pharyngeal plexus. Finally, the nerve is continued beneath the sterno-thyroideus, to supply the crico-thyroid muscle and the thyroid body. Near its origin this branch communicates with the sympathetic nerve (superficial cardiac branch).

Branches to
the heart at
upper
and lower
part of neck.

3. *Cardiac branches*.—Some small cardiac nerves arise from the pneumo-gastric at the upper part of the neck, and join cardiac branches of the sympathetic. At the lower part of the neck, on each side, there is a single cardiac nerve:—that of the right side enters the chest, and joins one of the deep nerves to the heart from the sympathetic; and on the left side the corresponding nerve terminates in the superficial cardiac plexus of the thorax.

Another
branch to
larynx,

ends in
muscles in
interior.

4. The *inferior laryngeal* or recurrent nerve of the right side leaves the pneumo-gastric trunk opposite the subclavian artery, and winding round that vessel, takes an upward course in the neck to the larynx. To reach its destination, the nerve ascends beneath the common carotid and inferior thyroid arteries, and then between the trachea and the oesophagus. At the larynx it enters beneath the ala of the

thyroid cartilage, and it will be afterwards traced into the interior. The following branches arise from it:—

a. Some *cardiac branches* leave this nerve as it turns round the subclavian artery; these enter the thorax, and join the cardiac nerves of the sympathetic. It has branches to heart,

b. *Muscular branches* spring from the recurrent nerve whilst it lies between the trachea and the oesophagus, and are distributed to both those tubes. Near the larynx also some filaments are furnished to the inferior constrictor muscle. to trachea, and oesophagus.

On the left side of the body the recurrent nerve arises in the thorax, opposite the arch of the aorta, around which it bends. In the neck its position is between the trachea and the oesophagus, as on the right side. Left recurrent nerve.

The SPINAL ACCESSORY NERVE (fig. 14, ³) passes through the foramen-jugulare with the pneumo-gastric, but is not marked by any ganglion while in the foramen. This nerve is constructed of two parts, viz. accessory to the vagus, and spinal, which have different origins and distributions. (See Origin of the cranial nerves.) Spinal accessory has two parts

The part *accessory to the vagus*, 11, is the smaller of the two, and finally blends with the vagus beyond the skull. In the foramen of exit from the skull, it lies close to the vagus; and here it joins the upper ganglion of that nerve by one or two filaments. accessory to vagus in foramen.

Having passed through the foramen, this part is applied to the vagus; it is then continued over the lower ganglion of that nerve, and blends with the trunk of the vagus only beyond the ganglion, 16. It gives offsets to join the pharyngeal and upper laryngeal branches of the vagus; and according to Bendz, offsets from it may be traced into many other branches of the same nerve. Below foramen; how ends.

The *spinal part* (fig. 14, ¹²) is much larger, is round and cord-like, and is connected with the smaller piece whilst it is passing through the foramen jugulare. Spinal part in foramen.

Beyond the foramen the nerve takes a backward course through the sterno-mastoid muscle, and across the side of the neck to the trapezius muscle. At first it is somewhat concealed by the jugular vein, but it then passes either over or under that vessel, to take the course above indicated. The connections of the nerve beyond the sterno-mastoideus have been already examined (p. 59). In the neck, crosses to trapezius.

This nerve furnishes muscular offsets to the sterno-mastoideus and the trapezius. Supplies muscles.

The HYPOGLOSSAL NERVE (ninth of Willis), after passing from the cranium by the anterior condyloid foramen, lies Ninth nerve

deeply beneath the internal carotid artery and the jugular vein. It then comes forwards between the vein and the artery, turning round the outer side of the vagus, to which it is intimately united. The nerve next descends in the neck, and becomes superficial below the digastric muscle in the anterior triangular space. From this spot the nerve is directed inwards to the tongue and its muscles.

The *branches* of this nerve are furnished to the muscles on the fore part of the neck, and to the muscular substance of the tongue ; but there are also some branches joining it with other nerves near the skull to be now considered.

Connecting branches.—*a.* Near the skull the hypoglossal is connected by branches with the vagus nerve, the two being almost inseparably united.

b. Rather lower down the nerve has connecting offsets with the sympathetic, and with the loop of the first two sympathetic and spinal ; spinal nerves.

The *cervical branches for distribution* to parts around are included in the description of the dissections of the neck, the submaxillary region, and the tongue.

Dissection.—The small rectus capitis lateralis muscle, between the transverse process of the atlas and the base of the skull, is now to be more completely cleaned. At its inner border the anterior branch of the first cervical nerve, which joins in the loop of the atlas, is to be found.

The RECTUS CAPITIS LATERALIS (fig. 23, ^a) is a small thin muscle, which is the representative of an intertransverse muscle. It *arises* from the anterior process (parapophysis), and the tip of the united transverse processes of the atlas ; and is inserted into the jugular eminence of the occipital bone. On the anterior surface rests the jugular vein ; and in contact with the posterior is the vertebral artery. To the inner side is the anterior primary branch of the first cervical nerve.

Dissection.—For the purpose of tracing backwards the anterior branch of the first cervical nerve to its ganglion, divide the rectus lateralis muscle, observing the branch of nerve to it ; then cut off the end of the lateral mass of the atlas, and remove the vertebral artery, so as to bring into view the nerve as it lies on the first vertebra.

The *anterior primary branch* of the *first* or sub-occipital nerve is slender in size, and arises from the common trunk on the neural arch of the atlas. From that origin it is directed forwards on the arch, beneath the vertebral artery, to the inner side of the rectus lateralis. Here the nerve

crosses
inwards to
tongue.

Branches
join it with

the vagus,

sympathetic
and spinal ;

and supplies
muscles.

Dissection
of rectus
lateralis.

Rectus
lateralis
is first inter-
transverse
muscle.

Dissection
of first
nerve.

Sub-occip-
ital nerve

lies on atlas,

bends down in front of the lateral mass, and forms a loop by uniting with the second cervical nerve. Branches pass between this loop and the vagus, hypoglossal, and sympathetic nerves. As the nerve passes forwards it supplies the rectus lateralis muscle, and sends a filament along the side of the vertebral artery.

forms a loop with second.

Branches.

SYMPATHETIC NERVE.—In the neck the sympathetic nerve consists, on each side, of a gangliated cord, which lies close to the vertebral column, and is continuous with the similar cord in the thorax. On this part of the nerve are three ganglia:—one near the skull, another on the neck of the first rib, and a third midway between the two; these are named respectively superior, inferior, and middle ganglion. From the ganglia proceed some branches that are connected with the spinal and most of the cranial nerves, and other branches that are distributed to viscera.

Sympathetic nerve in neck

has three ganglia:

Besides the ganglia above mentioned, there are other ganglionic masses in the head and neck, in connection with the three trunks of the fifth nerve.

other ganglia on fifth nerve.

Dissection.—To dissect the branches of the sympathetic nerve requires greater care than is necessary in following the white-fibred nerves, for they are softer, more easily torn, and generally of smaller size. In the neck the ganglia and their branches are already partly prepared, and will therefore require only the following additional dissection to bring them into view:—the carotid artery and jugular vein having been already cut through, the upper ganglion will be seen by raising the trunks of the eighth and ninth nerves, and cutting through the branches that unite these to the loop of the atlas. If it is thought necessary, the two cranial nerves may be cut across close to the skull. The several branches of the ganglion should be traced upwards, inwards, and outwards.

Dissection of

upper ganglion.

The dissector has already seen the middle ganglion on or near the inferior thyroid artery, and has to trace out now its branches.

Middle

To obtain a view of the inferior ganglion, the greater part of the first rib is to be taken away, and a part of the subclavian artery is to be removed, without however destroying the fine nerves that pass over it. Of course the clavicle is supposed not to be in position. The ganglion is placed on the neck of the first rib; its branches are large, and are easily followed to the vertebral artery, the spinal nerves, and the thorax.

and inferior ganglion.

- Superior ganglion is near skull, The SUPERIOR CERVICAL GANGLION is the largest of the cervical ganglia, and is of a reddish grey colour. Of a fusiform shape, it is as long as two cervical vertebræ (second and third), and is placed on the rectus capitis anticus major muscle, beneath the carotid artery and the cranial nerves in connection with it. Branches connect the ganglion with other nerves, and some are distributed to the bloodvessels, the pharynx, and the heart.
- beneath carotid. *Connecting branches* unite the sympathetic with both the spinal and the cranial nerves.
- Branches join it *With the spinal nerves.*—The four highest spinal nerves have branches of communication with the upper ganglion of the sympathetic; but the branch to the fourth spinal nerve may come from the cord connecting the upper to the next ganglion.
- with spinal nerves, *With the cranial nerves.*—Near the skull the trunks of the vagus (its lower ganglion) and hypoglossal nerves are joined by branches of the sympathetic. In the foramen jugulare also, both the petrosal ganglion of the glossopharyngeal and the ganglion of the root of the vagus receive small filaments, one to each, from an ascending offset of the ganglion.
- with cranial Communications are formed with other cranial nerves by means of the offset continued upwards from the ganglion into the carotid canal.
- outside skull, *Branches for Distribution.*—This set of branches is more numerous than the preceding, and the nerves are of larger size.
- and with some in the skull. 1. *Branches for bloodvessels* (nervi molles). These nerves proceed to the external carotid artery, and ramify on its branches, forming plexuses on the vessels, which have the same name as the arteries they surround. Some small ganglia are occasionally found on these ramifying branches.
- Branches are sent By means of the plexus on the facial artery the submaxillary ganglion communicates with the sympathetic; and through the plexus on the internal maxillary artery the otic ganglion is supplied with a similar communication.
- to external carotid, With these nerves may be described another offset of the ganglion to the internal carotid artery and its branches. This offset ascends from the upper part of the ganglion, of which it appears to be a continuation. Near the skull it divides into two pieces, which enter the canal for the carotid artery, one on each side of that vessel, and are continued, forming secondary plexuses on the ophthalmic and cerebral arteries, to the eyeball and the pia mater of the brain. In
- forming plexuses and ganglia; which joins cranial nerves;

the carotid canal communications are formed with the tympanic nerve (p. 116) and with the spheno-palatine ganglion (p. 150); the former being placed near the lower, and the latter near the upper opening of the canal. The communications and plexuses that these nerves form in their course to the base of the brain are described at p. 21.

2. The *pharyngeal nerves* pass inwards to the side of the pharynx, where they join in the pharyngeal plexus with the other pharyngeal branches of the eighth cranial nerve. to pharyngeal plexus.

Cardiac nerves.—The cardiac nerves enter the thorax to join in the cardiac plexuses of the heart. There are three cardiac nerves on each side, viz. superior, middle, and inferior, each taking its name from the ganglion of which it is an offset. to cardiac plexuses.

3. The *superior* or *superficial cardiac nerve* of the right side continues through the neck behind the sheath of the carotid vessels, and enters the thorax beneath, or in front of the subclavian artery. In some bodies this nerve ends in the neck by joining one of the other cardiac nerves. In the neck the nerve is connected with the cardiac branch of the vagus, with the external laryngeal, and with the recurrent nerve. One nerve to deep plexus joins others in neck.

The *MIDDLE CERVICAL GANGLION* (gang. thyroideum) is of small size, and is situate opposite the fifth cervical vertebra, usually on or near the inferior thyroid artery. It is of a roundish shape, and lies beneath the great cervical vessels. Its branches are the following :— Middle ganglion.

Connecting branches with the spinal nerves pass outwards, and sink between the borders of the longus colli and anterior scalenus to join the fifth and sixth cervical nerves. Is joined to spinal nerves,

Branches for Distribution.—These consist of nerves to the thyroid body, together with the middle cardiac nerve. and gives offsets, viz.

1. The *thyroid branches* ramify around the inferior thyroid artery, and end in the thyroid body; they join the external laryngeal and recurrent laryngeal nerves. thyroid branches

2. The *middle* or *great cardiac nerve* descends to the thorax across the subclavian artery; its termination in the cardiac plexus will be seen in the chest. In the neck it communicates with the upper cardiac and recurrent laryngeal nerves. and a cardiac nerve.

The *INFERIOR CERVICAL GANGLION* is irregular in shape, and occupies the interval between the first rib and the lateral mass of the last cervical vertebra, its position being internal to the superior intercostal artery. Oftentimes it extends in front of the neck of the rib, and joins the first Inferior ganglion is on neck of first rib.

Branches to swelling of the knotted cord in the thorax. One or two blood-vessels, filaments around the trunk of the subclavian artery likewise connect these ganglia, and supply filaments to that blood-vessel. Its branches are very similar to those of the other ganglia.

and spinal 1. *Connecting branches* join the last two cervical nerves. Other nerves accompany the vertebral artery in its canal, forming a plexus—*vertebral*, around it, and communicate with the spinal nerves as high as the fourth.

and one 2. Only one branch for distribution, the *inferior cardiac nerve*, issues from the lower ganglion. It lies beneath the nerve to car- subclavian artery, joining in that position the recurrent diac plexus. laryngeal nerve, and enters the thorax to terminate in the deep cardiac plexus behind the arch of the aorta.

Directions.—The remains of the right half of the head and neck should be carefully preserved during the time occupied in the examination of the left half.

SECTION X.

DISSECTION OF THE LEFT SIDE OF THE NECK.

Directions.—In repeating the dissection of the left half of the neck, the differences observable between it and the right side are specially to be studied. When the description of the right side will suffice, reference will be made to it.

Dissection of After the neck has been made tense over a narrow block, anterior tri- the anterior triangle and the anterior part of the neck are to angle of neck, be prepared as on the opposite side. The description of the right side (p. 63) is to be used for both those regions, for the sterno-mastoides, and for the depressor muscles of the hyoid bone.

of scaleni Next the scaleni muscles and the subclavian vessels are and subcla- to be taken. The dissection and description of those parts vian artery, on the right side (p. 69), will serve for these on the left, except that the student will meet on the left side with the thoracic duct. This little tube will be seen in connection with the part of the subclavian artery internal to the scalenus muscle, and crossing in front of the scalenus to join the subclavian vein. On this side, too, the clavicle may remain articulated.

Subclavian The LEFT SUBCLAVIAN ARTERY arises from the arch of the artery aorta, instead of from an innominate trunk, and ascends

thence over the first rib in its course to the upper limb. With this difference on the two sides in the origin of the subclavian,—the one vessel beginning opposite the sterno-clavicular articulation, the other in the thorax,—it is evident that the length and connections of the part of the artery on the inner side of the scalenus must vary much on opposite sides.

differs much from right subclavian

First part.—The part of the artery internal to the anterior scalenus is much longer on the left than the right side, and is almost vertical in direction, instead of being horizontal like its fellow. Moreover, after it leaves the chest it is deeply placed in the neck, near the spine and the œsophagus, and does not rise so high above the first rib as the right subclavian. Between the artery and the surface are the same parts as are superficial to the right vessel, viz. the common teguments and deep fascia, with the sterno-mastoid, hyoid, and thyroid muscles. Behind the vessel is the longus colli muscle, with the inferior ganglion of the sympathetic. To the inner side are the œsophagus and the thoracic duct; and the pleura is in contact with the anterior and outer parts. Its connections lower in the chest are described in the dissection of the thorax.

in the first part of its extent.

Connections with surrounding parts.

The pneumo-gastric nerve is in connection with this part of the artery, but its position is parallel to the vessel instead of across it as on the right side. The internal jugular vein, in like manner, is parallel to the artery for a short distance, and superficial to it. Accompanying also the subclavian artery are the cardiac branches of the sympathetic, which course along the side of the vessel to the chest.

Position of vagus

and internal jugular vein to it.

The *second* and *third* parts of the artery, viz. beneath and beyond the scalenus, are nearly the same as on the right side; but the student must note for himself the variations that may exist in the connections.

Rest of the artery.

The *branches* of this artery resemble so closely those of the right trunk, that one description will serve for both. It may be remarked, that the superior intercostal of the left side is usually internal to, instead of beneath the scalenus; in other words, this branch arises sooner (see p. 73).

Branches resemble those of right vessel.

The *thoracic duct* conveys the chyle and lymph of the greater part of the body into the venous circulation. Escaping from the thorax between the subclavian artery and the œsophagus, the duct ascends in the neck as high as the seventh or sixth cervical vertebra. At the spot mentioned as its highest extent, the duct arches outwards above the subclavian artery, and in front of the scalenus muscle and

Thoracic duct comes from the thorax

- and joins
subclavian
vein. the phrenic nerve, to open into the subclavian vein close to its union with the internal jugular vein. Double valves, like those of the veins, are present in the interior of the tube ; and two guard the opening into the posterior part of the vein, to prevent the passage of the blood into it. Commonly the upper part of the duct is divided ; and there may be separate openings into the large vein, corresponding with those divisions.
- Structure. *Structure.*—This tube is formed of three coats like the vessels, viz. inner, middle, and outer. The inner is an elastic reticulate layer of longitudinal fibres covered by epithelium ; the middle is muscular and elastic with transverse fibres ; and the outer is constructed chiefly of fibrous tissues arranged longitudinally.
- Spinal
nerves. Examine next the brachial and cervical plexuses, using the description of the right side (p. 76).
- Difference
in origin of
right and
left carotids. COMMON CAROTIDS.—On opposite sides these vessels have differences like those between the right and left subclavian arteries ; for on the left side the vessel arises alone, and from the arch of the aorta, and is therefore deep in the chest and longer than the right. The part of the artery between its origin and the upper piece of the sternum will be seen in the dissection of the thorax.
- In the neck Beyond the sterno-clavicular articulation the vessels, on both sides, so nearly resemble one another that the same description will serve for the two (p. 79). It must be remarked however that, on the left side, the jugular vein and the pneumo-gastric nerve are much nearer to the accompanying artery than on the right side, and are placed over the artery in the lower third of the neck.*
- difference in
vein and
nerve. The THYROID BODY is a soft reddish mass, which is situate opposite the upper part of the trachea. It consists of two lobes, one on each side, which are united by a narrow piece across the front of the windpipe. The connecting piece, about half an inch in depth, is named the *isthmus*, and is placed opposite the second and third rings of the air tube.
- Thyroid
body
consists of
two lobes
united by a
cross piece. Each lobe is somewhat conical in shape, with the smaller end upwards, and is about two inches in length. It is interposed between the windpipe and the sheath of the common carotid artery, and is covered by the sterno-thyroid, sterno-hyoid, and omo-hyoid muscles. The extent of the lobe depends upon variations in its size ; but usually the lateral
- Connections
and
- extent of
lobes.

* Sometimes these differences will be reversed—the vein and nerve being over the artery on the right side, and away from it on the left.

piece reaches as high as the ala of the thyroid cartilage, and as low as the sixth ring of the trachea.

From the upper part of the thyroid body, and most commonly from the left lobe, there is occasionally found a conical piece—*pyramid*, ascending towards the hyoid bone, to which it is connected by a fibrous band. Sometimes this part is attached to the hyoid bone by a slip of muscle, the *levator glandulae thyroideae* of Sömmerring.

This body is of a brownish red or purple hue, is granular in texture, and weighs from one to two ounces. Its size is larger in the woman than in the man. On cutting into the gland a viscid yellowish fluid escapes. No excretory tube has been found attached to it.

Structure.—The thyroid body is not provided with a distinct capsule; but it is surrounded by areolar and fine elastic tissues, which project into the substance and divide it into masses.

The substance of the gland consists of spherical or elongated vesicles, which vary in size, some being as large as the head of a small pin, and others only $\frac{1}{350}$ th of an inch. These vesicles are simple sacs, distinct from one another, and contain a clear yellowish fluid. In the wall of the vesicles is found a thin proper membrane with a nucleated epithelial lining. Capillary vessels and connective tissue unite the vesicles together into small irregular masses or lobules of the size of the little finger nail.

Bloodvessels.—The *arteries* to the thyroid body are two on each side—superior and inferior thyroid; and occasionally there is an additional branch—lowest thyroid from the innominate artery. The branches of the external carotid (superior thyroid) ramify chiefly on the anterior aspect; while those from the subclavian (inferior thyroid) pierce the under surface of the thyroid body. A very free communication is established between all the arteries; and in the substance of the thyroid body the arteries form a fine network around the vesicles, and so pass into the radicles of the veins.

The *veins* are also large and numerous; they are superior, middle, and inferior thyroid on each side. The first two have been traced to the internal jugular vein (p. 81). The *inferior thyroid veins*, two in number, issue from the lower part of the thyroid body, and descend on the trachea, the two forming a plexus on that tube beneath the sterno-thyroid muscles; each enters finally the innominate vein of its own side.

The *TRACHEA*, or air tube, is continued from the larynx to Trachea

- the thorax, and ends by dividing into two tubes (bronchi), one for each lung. It occupies the middle line of the body, and extends commonly from the fifth cervical to the third dorsal vertebra, measuring about four inches and a half in length, and nearly one in breadth. The front of the trachea is rounded in consequence of the existence of firm cartilaginous bands in the anterior wall, but at the posterior aspect the cartilages are absent, and the tube is flat and muscular. Its cavity remains pervious in health under all conditions.
- Cervical part is amongst muscles** The cervical part of the trachea is very moveable, and has the following relative position to the surrounding parts. Covering it in front are the small muscles reaching from the sternum to the hyoid bone, with the deep cervical fascia : beneath the muscles is the inferior thyroid plexus of veins ; and near the larynx is the isthmus of the thyroid body. Behind the tube is the œsophagus, with the recurrent nerves.
- and vessels.** On each side are the common carotid artery and the thyroid body.
- œsophagus** The structure of the trachea is described in Section VII. The œSOPHAGUS, or gullet, reaches from the pharynx to the stomach. It commences, like the trachea, opposite the fifth cervical vertebra, and ends opposite the tenth dorsal vertebra. In length it measures about nine inches. This tube reaches through part of the neck, and through the whole of the thorax, and occupies for the most part the middle line of the body.
- occupies neck and thorax.**
- Position in neck** In the neck its position is behind the trachea, till near the thorax, where it projects to the left side beyond the air tube, and comes into connection with the thyroid body and the thoracic duct. Behind the œsophagus is the longus colli muscle. On each side is the common carotid artery, the proximity of the left being greatest because of the projection of the œsophagus towards the same side.
- and connections.** The structure of the œsophagus will be examined in the dissection of the thorax.
- Muscles and vessels in anterior triangle.** *Directions.*—The dissector may learn next the digastric and stylo-hyoid muscles, with the hypoglossal nerve ; and afterwards, the trunk of the external carotid, with the following branches,—superior thyroid, facial, occipital, posterior auricular, and superficial temporal. The description of the right side (p. 81) may be used for these parts.
- Pterygo- and sub-maxillary regions to be omitted.** The dissector is not to examine the pterygo-maxillary or submaxillary regions on this (the left) side of the neck, because such a proceeding would interfere with the sub-

sequent dissections. Before learning the pharynx he should lay bare, on this side, the middle and inferior ganglia of the sympathetic with their branches.

Dissection.—For the dissection of the two lower ganglia of the sympathetic and their branches, it will be necessary to cut across the common carotid artery at the lower part of the neck, and the external and internal carotid where these are crossed by the digastric muscle. In removing the vessels with the internal jugular vein, care must be taken of the sympathetic beneath them. The upper end of the sternum with its attached clavicle is to be taken away next, by cutting through the middle of the first rib; and the piece of bone thus obtained is to be put aside for the subsequent examination of the sterno-clavicular articulation. The middle ganglion must be sought in the fat and areolar tissue near the inferior thyroid artery; and the inferior one will be seen on the neck of the first rib, after a piece of the subclavian artery has been cut out. The upper cardiac nerve will be found descending beneath the carotid sheath.

The middle and inferior cervical ganglia of the sympathetic nerve are so similar to the corresponding ganglia of the right side, that the same description will suffice (p. 123).

The cardiac nerves are three in number on the left as on the right side, viz. superior, middle, and inferior, but they present some peculiarities.

1. The superior cardiac nerve has a similar course in the neck on both sides; but the left in entering the chest is between the carotid and subclavian arteries, and parallel to them.

2. The middle cardiac nerve unites frequently with the next nerve, and passes beneath the subclavian artery to the deep cardiac plexus.

3. The inferior cardiac nerve is generally a small branch, which enters the thorax conjoined with the preceding, and ends in the cardiac plexus.

SECTION XI.

DISSECTION OF THE PHARYNX.

The pharynx, or the commencement of the alimentary passage, can be examined only when it has been separated from the rest of the body; and it will therefore be necessary to cut through the base of the skull in the manner mentioned

below, so as to have the anterior half, with the pharynx connected to it, detached from the posterior half.

To detach
pharynx

Dissection.—Preparatory to sawing the skull certain other steps are needed. In the first place, the block being removed from beneath the neck, the head is to be placed downwards, so that it may stand on the cut surface of the skull. Next the trachea and œsophagus, together with the vagus and sympathetic nerves, are to be cut near the first rib (should these be still uncut), and all are to be separated from the spine as high as the basilar process of the occipital bone, but without disturbing, on the left side, the vessels and nerves near the skull.

partly divide
base of skull
externally,

For the division of the skull, let the dissector chisel through the basilar process of the occipital bone between the attachments of the pharynx and the muscles of the spinal column, the cut being directed backwards. Turning upwards next the inner surface of the base of the skull, the dissector will make the following incisions in the posterior fossa. On the right side, a cut with a chisel is to be carried along the line of union of the petrous part of the temporal with the occipital bone, as far inwards as the incision across the basilar process. On the left side, another cut with the chisel is to be made in the same direction, but through the occipital bone, internal to the foramen jugulare and the inferior petrosal sinus: this is to begin rather behind the foramen, and to end opposite the one on the other side. Lastly, the side of the skull is to be sawn through vertically close behind the mastoid part of the temporal bone, so that the incision shall meet the outer end of the cut made with the chisel. The base of the skull is now divided into two parts, (one having the pharynx attached to it, the other articulating with the spine) which can be readily separated with a scalpel.

and cut the
remainder
from inside,

and then
cut soft
parts.

Preserve
piece of
spine.

The spinal column with the piece of the occipital bone connected with it should be set aside and kept for after examination.

Fasten
pharynx in
position.

Dissection of the pharynx.—Let the student take the anterior part of the divided skull, and, after moderately filling the pharynx with tow, fasten it with hooks on a block, so that the œsophagus may be pendent and towards him.

Dissect
nerves on
left side,

On the left side of the pharynx a view may be obtained of the eighth, ninth, and sympathetic nerves near the skull, when some loose areolar tissue, and the styloid process with its muscles have been removed.

and muscles

Afterwards, on one side, say the right, the dissector may



EXTERIOR OF THE PHARYNX.

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proceed to remove the fascia from the constrictor muscles in the direction of their fibres, these radiating from the side to the middle line. The margins of the two lower constrictor muscles (middle and inferior) are to be defined. Beneath the lower one near the larynx, will be found the recurrent nerve; whilst intervening between the middle and superior, are the stylo-pharyngeus muscle and the glosso-pharyngeal nerve. To see the attachment of the superior constrictor to the lower jaw and the pterygo-maxillary ligament, it will be necessary to cut through the internal pterygoid muscle. Above the upper fibres of this constrictor, and near the base of the skull (petrous part of the temporal bone), will be found two small muscles of the palate:—one,—tensor palati, lies between the internal pterygoid plate and the pterygoid muscle; and the other,—*lévator palati*, is rather farther back, and of larger size.

The PHARYNX is that part of the alimentary tube which is situate behind the nose, mouth, and larynx. Through the part of this passage above the mouth the air moves in respiration, whilst through that below the mouth both air and food are transmitted; the air passing to the aperture of the windpipe and the food to the œsophagus. Its extent is from the base of the skull to the cricoid cartilage of the larynx, where it ends in the œsophagus. In form it is somewhat conical, with the dilated part upwards, and the apex or narrower part downwards. In length it measures about four inches and a half.

The tube of the pharynx is incomplete in front, where it communicates with the cavities above mentioned, but is quite closed behind. On each side of the pharynx are the trunks of the carotid arteries, with the internal jugular vein and the accompanying eighth, ninth, and sympathetic nerves. Behind it is the spinal column, covered by the deep muscles, viz. *longus colli* and *rectus capitis anticus major*.

In front the pharynx is attached to the larynx, the hyoid bone and the tongue, and to the bony framework of the nasal cavity; but behind it is unattached, and is formed of thin, fleshy and membranous strata. In the posterior wall are three thin muscles, which are so arranged that the lower overlays the middle, and the middle the upper muscle, like the disposition of scales; and at the upper part the bag is farther completed by an aponeurotic expansion which fixes it to the base of the skull. The whole is lined by mucous membrane.

The aponeurosis of attachment is seen at the upper part of

on the opposite.

Pharynx is behind mouth and nose.

Extent,

form, and

length.

Is an incomplete bag;

is between blood-vessels and in front of spine.

Attachments.

Construction.

Aponeurosis of pharynx.

during deglutition. And lowest of all is the opening from the pharynx into the œsophagus.

Seven aper-
tures, viz.

The *apertures* into the pharynx then are seven in number, and have the following position and boundaries :—

Posterior
nares.

The posterior *openings* of the *nasal fossæ* are oval in form, and measure about an inch from above down, but only half an inch across. Each is constructed of the sphenoid and palate bones with the vomer in the dried skull, and is lined by mucous membrane.

Eustachian
tube;

The *Eustachian tube* is a canal, partly osseous, partly cartilaginous, by which the tympanic cavity of the ear communicates with the external air. Only the cartilaginous part that is external to the bone can be now seen.

cartilagi-
nous part is
an inch long.

If the mucous membrane be removed from the tube on one side, the cartilaginous part appears to be nearly an inch long. It is narrow superiorly, where it is fixed to the margins of a groove between the sphenoid and the petrous part of the temporal bone; directed downwards to the pharynx, it ends by a wide aperture opposite the inner surface of the internal pterygoid plate, and rather above the inferior spongy bone of the nose. Its opening in the pharynx is oval in form; and the inner side, which is larger than the outer, projects forwards, giving rise to a trumpet-shaped mouth. This part of the tube is constructed chiefly by a triangular piece of cartilage, whose margins are bent downwards so as to enclose a narrow space; but at the outer and under aspect the cartilage is deficient, and the wall is formed by fibrous membrane. Closely united to the pterygoid plate, the tube is covered by the mucous membrane; and through it the mucous lining of the cavity of the tympanum is continuous with that of the pharynx.

has a wide
opening;

is a bent
piece of
cartilage.

Mucous
membrane
covers and
lines it.

Opening of
the fauces.

The *isthmus faucium* is a somewhat narrowed passage between the mouth and the fauces, whose size is altered by the elevated or pendent position of the soft palate. The space is bounded below by the root of the tongue; above by the soft palate; and on each side by the projecting arches of the soft palate, which are named *pillars* of the *fauces*.

Upper
opening of
larynx.

The *aperture of the larynx* is wide in front, where it is bounded by the epiglottis, and pointed behind between the arytenoid cartilages. The sides are sloped from before back, and are formed by folds of the mucous membrane extending between the arytenoid cartilages and the epiglottis. During respiration this aperture is unobstructed, but in the act of deglutition it is closed by the epiglottis.



INTERIOR OF THE PHARYNX.

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jaw, and with the mucous membrane of the mouth and the side of the tongue. The fleshy fibres pass backwards, and are inserted on the aponeurosis of the pharynx, as well as into the *raphè* along the middle line. The parts in contact, externally, with this muscle are all the deep vessels and nerves of the neck; and internally it is lined by the aponeurosis and the mucous membrane. The upper border consists of the arched fibres which are directed backwards from the pterygoid plate, and above it the levator and tensor palati muscles are seen. The lower border is overlaid by the middle constrictor muscle. The attachment to the pterygo-maxillary ligament corresponds with the origin of the buccinator muscle.

Insertion
behind as
the others.

Contiguous
parts.

Dissection.—Open the pharynx by an incision along its middle, and, after removing the tow from the interior, keep it open with hooks. A better view of the cavity will be obtained by partly dividing the occipital attachment on each side. The mucous membrane is to be carefully removed from the dilated extremity of the Eustachian tube by the side of the opening into the nose, for the purpose of finding some pale muscular fibres, with the name salpingo-pharyngeus, which descend from it.

Dissection.

Salpingo-pharyngeus muscle.—This little band is fixed by tendon to the lower border of the cartilage of the Eustachian tube near the orifice. The fleshy fibres that succeed end below by joining those of the palato-pharyngeus. It is oftentimes not seen.

Salpingo-
pharyngeus.

Attach-
ments.

The interior of the pharynx is wider from side to side than from before back, and its greatest width is opposite the hyoid bone; from this spot it diminishes both upwards and downwards, but much more rapidly in the latter than in the former direction. In it the following objects are to be noticed:—At the top are the posterior apertures of the nasal cavity, which are separated by the septum nasi; and below them is the soft palate, partly closing the cavity of the mouth. By the side of each nasal aperture is the trumpet-shaped end of the Eustachian tube. Below the soft palate is the opening into the mouth—isthmus faucium; and on each side of this is the tonsil, which is placed in a hollow between two prominences named pillars of the soft palate,—the one proceeding from the front of the soft palate to the side of the tongue, and the other from the same part to the side of the pharynx. Next in order, below the mouth, is the aperture of the larynx: and close in front of it is the epiglottis, or the valve which assists to close that opening

Interior of
pharynx.

Objects to
be noted.

goid plate. The position of the Eustachian tube with respect to those muscles should be defined.

On left,
palato-pharyngeus,

azygos
uvulæ,

and palato-glossus.

Aponeurosis
of palate.

Nine
muscles.

Elevator
muscle
arises out-
side pha-
rynx,

and is lost
in velum.

Tensor
muscle

arises out-
side pha-
rynx,

On the left side, the mucous membrane is to be raised with care from the posterior surface of the palate, to obtain a view of the superficial muscular fibres: for immediately beneath the mucous covering are some transverse fibres of the palato-pharyngeus muscle; and beneath these, in the middle line, are the longitudinal fibres of the azygos uvulæ. The student should remove next the mucous membrane from the muscular fibres constituting the arches of the palate, and should follow them upwards and downwards: in order to see those of the anterior fold, it will be necessary to take the membrane from the anterior surface of the palate. If the part is not tolerably fresh, some of the paler fibres will not be visible.

Aponeurosis of the soft palate.—Giving strength to the velum is a thin but firm aponeurosis, which is attached to the hard palate. This membrane becomes thinner as it descends in the velum; and it is joined by the tendon of the tensor palati muscle.

The MUSCLES of the soft palate are four on each side,—an elevator and tensor; together with the palato-glossus and palato-pharyngeus, which act as depressors. In addition there is a small central azygos muscle.

The LEVATOR PALATI is a thick, roundish muscle, and is partly situate outside the pharynx. It arises from the under surface of the apex of the petrous portion of the temporal bone, and from the inner and under part of the cartilage of the Eustachian tube. The fibres descending, enter the pharynx above the superior constrictor, and then spread out in the soft palate, where they join along the middle line with those of the muscle of the opposite side. Outside the pharynx this muscle rests against the Eustachian tube. In the palate it forms a stratum that reaches the whole depth of that structure, and is embraced by the two planes of fibres of the palato-pharyngeus.

The TENSOR vel CIRCUMFLEXUS PALATI arises like the preceding outside the palate and pharynx: it is a thin, riband-like band, which is situate between the internal pterygoid plate and the pterygoid muscle. The muscle is about one inch and a half wide at its origin, and is attached to the slight depression (scaphoid fossa) at the root of the internal pterygoid plate, to the outer part of the Eustachian tube, and still farther out to the spinous process of the sphenoid, and to the front of the vaginal (tympanic) process of the



VELUM PENDULUM PALATI.

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The *opening into the cesophagus* is the narrowest part of the pharynx, and is opposite the cricoid cartilage, or the fifth cervical vertebra. Internally the mucous membrane in the cesophagus is paler than in the pharynx; and externally the point at which the pharynx ends is marked by a slight contraction, and by a change in the direction of the muscular fibres.

The **SOFT PALATE** (*velum pendulum palati*) is a moveable structure between the mouth and the pharynx, which can either close the isthmus of the fauces, or cut off the passage to the nose, according as it is depressed or elevated. In the usual position of the soft palate (the state of relaxation) the anterior surface is somewhat curved, and is continuous with the roof of the mouth, whilst the opposite surface is convex and turned to the pharynx. The upper border is fixed to the posterior margin of the hard palate; and each lateral part joins the pharynx. The lower border is free, and presents in the centre a conical pendulous part—the *uvula*. Along the middle line is a slight prominence, indicative of the original separation into two halves.

Springing from the lower part of the soft palate, near to the uvula, are two folds on each side, containing muscular fibres, which are directed downwards on the sides of the isthmus faucium. These are named *arches* or *pillars* of the palate, and are distinguished from one another by their relative position. The *anterior* one reaches the side of the tongue near its root; and the *posterior*, longer than the other, is continued to the side of the pharynx. As they diverge from their origin to their termination, they limit a triangular space, in which the tonsil lies.

The velum consists of an aponeurosis, together with muscles, vessels and nerves, and mucous glands; and the whole is enveloped by the mucous membrane.

Dissection.—Some of the muscles of the palate are readily displayed, but others require great care in their dissection.

On the right side the two principal muscles of the soft palate—the elevator and tensor, are to be seen. These have been partly dissected on the outside of the pharynx, but to follow them to their termination, let the upper attachment of the pharynx on the same side, and the part of the superior constrictor which arises from the internal pterygoid plate, be cut through. The levator will be fully laid bare by the removal of the mucous membrane and the muscular fibres covering its lower part; and the tendon of the tensor palati should be followed round the hamular process of the ptery-

Beginning of cesophagus.

Soft palate is at back of mouth;

surfaces,

borders;

from it hangs uvula.

Arches or pillars;

anterior, posterior.

Constituent of velum.

Dissection of the muscles.

Levator and tensor on right half.

muscle is single along middle;

attach-ments.

Tonsil is between pillars of palate.

Vessels.

Nerves.

Mucous membrane of pharynx continued into the apertures.

Superiorly has columnar, inferiorly scaly epithelium.

Beginning of œsophagus.

Formed of two layers of fibres;

velum near the posterior surface. The muscle consists of two narrow slips of pale fibres, which *arise* from the spine at the posterior border of the hard palate, or from the contiguous aponeurosis, and end inferiorly in the tip of the uvula. Behind this muscle, separating it from the mucous membrane, is the thin stratum of the palato-pharyngeus.

The *tonsil* is a collection of mucous follicles resembling those on the dorsum of the tongue, which is placed close above the base of the tongue, and between the arches of the soft palate. Each is roundish in shape, but variable in size, and apertures are more or less apparent on its surface. Externally the tonsil is opposite the superior constrictor muscle and the angle of the lower jaw; and when enlarged it may press against the carotid blood-vessels.

Its *arteries* are numerous and are derived from the facial, lingual, ascending pharyngeal, and internal maxillary branches of the external carotid. Its *veins* have a plexiform arrangement on the outer side. *Nerves* are furnished to it from the fifth and eighth cranial nerves.

The *mucous membrane of the pharynx* is continuous anteriorly with the lining of the mouth and nose. Covering the soft palate and its numerous small glands (palatine), the membrane is continued to the tonsils on each side, and is prolonged by the Eustachian tube to the tympanum. From the dorsum of the tongue it is continued over the epiglottis, forming three small folds, and then lines the pharynx. In front of each arytenoid cartilage it encloses a mass of muciparous glands (arytenoid). It is prolonged into the larynx through the upper opening. Inferiorly, it is continued by the œsophagus to the stomach.

The mucous membrane is thicker, redder, and better provided with glands in the upper, than in the lower part of the pharynx; and its character, near the different apertures, resembles that of the membrane lining the cavities opening into the pharynx. Its epithelium is scaly below the palate, that is to say, in the part through which the food passes; but columnar and ciliated above that spot, where only the air is transmitted.

Beginning of the œsophagus.—In addition to what has been said of the commencement of the œsophagus, and its connections in the neck, it may be remarked, that the size of this tube is less than that of the pharynx, and that the walls are flaccid.

On dissection the tube will be found to consist of two layers of muscular fibres, with a lining of mucous membrane.

temporal bone. Inferiorly the fleshy fibres end in a tendon, which is reflected round the hamular process, and is inserted into about half an inch of the posterior border of the palate, viz. from the central spine to a projecting point; whilst inferiorly the tendon joins the aponeurosis of the velum. As the tendon winds round the bone, it is thrown into folds; and in the soft palate it lies beneath the levator muscle. The Eustachian tube is directed inwards between this muscle and the preceding. Between the tendon and the hamular process is a small bursa.

turns
around
hamular
process,

and ends in
aponeurosis;
is deeper
than the
other.

The PALATO-GLOSSUS MUSCLE (constrictor isthmi faucium) is a small, fleshy band of fibres, which is contained in the anterior arch of the soft palate, and reaches to the side of the tongue. The muscles of opposite sides narrow the opening between the mouth and fauces, hence the name that has been applied to them. It is connected inferiorly with the lateral surface and the dorsum of the tongue; from this spot the fibres ascend before the tonsil, to the anterior aspect of the soft palate, where they form a thin muscular stratum, and join those of the fellow muscle along the middle line. At its origin the muscle is blended with the glossal muscles, and at its insertion it is placed before the tensor palati.

Palato-glos-
sus.

Attach-
ments.

The PALATO-PHARYNGEUS is much larger in size than the preceding muscle; it gives rise to the eminence of the posterior pillar of the soft palate, and bounds the tonsil posteriorly. The muscle is attached below to the posterior border of the thyroid cartilage; and some fibres blend with the contiguous portion of the pharynx, whilst others decussate across the middle line with corresponding fibres of the muscle of the opposite side (Merkel).^{*} Ascending thence behind the tonsil, the fibres enter the side of the palate, and separate into two fleshy strata. The posterior of the two, thin and in contact with the mucous membrane, joins at the middle line a like offset of its fellow. The deeper or anterior stratum, much the strongest, enters the substance of the palate between the levator tensor, and joins also, at the middle line, the corresponding part of the opposite muscle. In the palate the muscle encloses the levator palati and azygos uvulæ between its two strata.

Palato-pharyngeus, in
pillar of soft
palate.

Attach-
ments.

The AZYGOS UVULÆ is situate along the middle line of the

Azygos

^{*} Dr. Merkel, in the elaborate work before referred to, states that this muscle has no firm fixed attachment below, and that it ends altogether in the wall of the pharynx, decussating with the muscle of the opposite side. This assertion does not accord with my experience.

- floor, front in a small papilla. In the floor of the mouth the membrane forms the *frænum linguae* beneath the tip of the tongue, and sends tubes into the openings of the Whartonian and sublingual ducts ; whilst on each side of the *frænum* it is raised into a ridge by the subjacent sublingual gland. On
- cheek, and lips. the interior of the cheek and lips the mucous lining is smooth, and is separated from the muscles by small buccal and labial glands in addition to the ordinary submucous tissue. Over the whole oral cavity, but especially on the lips, are found papillæ for the purpose of touch. The epithelium
- Epithelium. covering the membrane is of the scaly nucleated variety.
- Cheek ; The CHEEK extends from the commissure of the lips to extent the ramus of the lower jaw, and is attached above and below to the alveolar process of the jaws on the outer aspect. The
- and struc- the chief constituent of the cheek is the fleshy part of the buc- ture. cinator muscle : on the inner surface of this is the mucous membrane ; and on the outer the integuments, with some muscles, vessels, and nerves. The parotid duct perforates the cheek near the second molar tooth of the upper jaw, and receives a lining of the mucous membrane.
- Lips, The LIPS surround the opening of the mouth ; they consist formed by of the fleshy part of the orbicularis oris muscle, covered orbicularis ; externally by integument, and internally by mucous membrane. The lower lip is the larger and more moveable of the two. Between the muscular structure and the mucous
- contains covering are the labial glands ; and in the substance of the coronary artery. lip, nearer the inner than the outer surface, and at the line of junction of the two parts of the orbicularis, is the arch of the coronary artery.
- Teeth, TEETH.—In the adult there are sixteen teeth in each jaw, number and which are set in the alveolar border of the maxillæ in the arrangement in form of an arch, and are surrounded by the gums. Each jaw ; dental arch has its convexity turned forwards ; and, commonly, the arch in the upper overhangs that in the lower maxilla when the jaws are in contact. The teeth are similar in the half of each jaw, and have received the following names :—the most anterior two are incisors, and the one
- different next behind is the canine tooth ; two, still farther back, are kinds. the bicuspid ; and the last three are molar teeth. Moreover, the last molar tooth has been called also “*dens sapientiae*,” from the late period of its appearance. The
- Use in mas- names applied to the teeth indicate very nearly the part tication. they perform in mastication ; thus the incisor and canine teeth act as dividers of the food, whilst the bicuspid and molar teeth serve to grind the aliment.

The several parts of the teeth, viz. the crown, fang, and neck ; the general and special characters of these parts, and of the different groups of the teeth ; and the structure of the different components of a tooth, must be referred to elsewhere.*

Fuller notice
elsewhere.

SECTION XIII.

DISSECTION OF THE NOSE.

To obtain a view of the interior of the nose, it will be necessary to make a longitudinal section through the base of the skull. Whilst the student is examining the boundaries of the nose he should be provided with a vertical section of a skull.

Directions.

Dissection.—Before making the necessary sawing of the bone, the loose part of the lower jaw on the right side should be taken away ; further, the tongue, hyoid bone, and larynx, all united, may be detached from the opposite half of the lower jaw, and laid aside till the dissector is ready to use them.

Dissection
before saw-
ing bone.

The saw being placed on the right side of the crista galli of the ethmoid bone, is to be carried vertically through the frontal and nasal bones, the cribriform plate of the ethmoid, and part of the body of the sphenoid bone. Now the roof of the mouth is to be turned upwards, and the soft parts are to be divided on the right of the median line, opposite the cut in the roof of the nose ; and the saw is then to be carried through the hard palate on the right side of the septum nasi, and through the body of the sphenoid bone, in such a direction as to make the cut join the incision from above. The piece of the skull is now easily separated into two parts, right and left ; and by proceeding as above directed, the delicate bones of the nose are less injured than they would be by sawing continuously in one direction. The right half will serve for the examination of the meatuses, and the left will show the septum nasi.

Cut through
the bone
with saw.

The CAVITY OF THE NOSE is placed in the centre of the bones of the face, being situate above the mouth, and between the orbits and the sinuses of the superior maxillary

Situation of
nose.

* For this information the student may refer to the account of the teeth that has been given by Dr. Sharpey, in *Quain's Anatomy*, vol. iii., p. 87.

Division into two.	bones. This space is divided into two parts—nasal fossæ, by a vertical partition.
Form.	Each fossa is larger below than above ; and is flattened in form, so that the measurement from before back or above down exceeds much that from within out. It communicates with both the face and the pharynx by apertures named nares, and has also apertures of communication with the sinuses in the surrounding bones, viz. frontal, ethmoid, sphenoid, and superior maxillary. In each fossa are a roof and floor, an inner and an outer wall, and an anterior and a posterior opening, which are to be examined.
Openings.	
Roof.	The <i>roof</i> is somewhat arched, and is formed by the cribriform plate of the ethmoid bone in the centre ; by the frontal and nasal bones and the cartilages in front ; and by the body of the sphenoid, the sphenoidal spongy bone, and part of the palate bone at the posterior part. Many apertures exist in the ethmoid bone for the passage of the olfactory nerves ; and in the front of the body of the sphenoid is the opening of its sinus.
Floor.	The <i>floor</i> is slightly hollowed from side to side, and in it are found the palate and superior maxillary bones—their palate processes. Near the front is the incisor foramen leading to the anterior palatine fossa.
Inner boundary partly osseous.	The <i>inner boundary</i> (septum nasi) is partly osseous and partly cartilaginous, and will be seen when the lining membrane has been removed. The osseous part is constructed by the vomer, by the perpendicular plate of the ethmoid bone, and by those parts of the frontal and nasal with which this last bone articulates above. The irregular space in front in the prepared skull is filled by the <i>triangular cartilage of the septum</i> , which forms part of the partition between the nostrils, and supports the cartilages of the anterior aperture. Fixed between the vomer, the ethmoid plate, and the nasal bones, the cartilage rests anteriorly on the median ridge between the superior maxillæ, and projects even between the cartilages of each nostril. The septum nasi is commonly bent to one side.
partly cartilaginous.	
Outer boundary,	The <i>outer boundary</i> has the greatest extent and the most irregular surface. Six bones enter into the formation of this wall, and they come in the following order, when enumerated from before backwards :—the nasal and superior maxillary ; the small os unguis with the lateral mass of the ethmoid bone ; and posteriorly the ascending part of the palate bone, with the internal pterygoid plate of the sphenoid bone : of these, the nasal, unguis, and ethmoidal reach only
formed of many bones,	

about half way from roof to floor, whilst the others extend the whole depth. Altogether in front of the bones, the lateral cartilages may be said to construct part of this boundary. On this wall are three convoluted osseous pieces, named *spongy* or *turbinate bones* (fig. 15), which project into the cavity:—the two upper, 5 and 6, are processes of the ethmoid, but the lower one is a separate bone, viz. the inferior spongy. The spongy bones are confined to a certain portion of the outer wall, and their extent would be limited by a line continued nearly vertically upwards to the roof of the cavity from both the front and back of the floor. Between each turbinate bone and the wall of the nose is a

is irregular on surface; extent of spongy bones:

presents hollows.

Fig. 15.*



longitudinal hollow or meatus; and into these hollows the nasal duct and the sinuses of the surrounding bones open.

The *meatuses* are the spaces arched over by the spongy bones; and as the bones are limited to a certain part of the outer wall, so are the spaces determined by them.

The *upper* one (fig. 15) is the smallest and straightest of the three meatuses, and equals in length about the posterior two thirds of the space included by the vertical lines before

Upper meatus, or meatus.

* Spongy bones and meatuses of the nasal cavity. 5. Upper spongy bone. 6. Middle spongy bone. 7. Inferior spongy bone. The three meatuses are the spaces beneath the spongy bones. Above the upper spongy bone is the fourth or rudimentary meatus. 8. Opening of the Eustachian tube. The woodcut shows also the glands of the nose.

mentioned. Into it the posterior ethmoidal sinuses open at the front ; and at its posterior part, in the dried bone, is the sphenopalatine foramen by which the nerves and vessels enter the nose.

Middle
meatus.

The *middle meatus* (fig. 15) is longer than the preceding ; it is curved upwards in front, and reaches all across the space referred to on the outer wall. Anteriorly it communicates by a funnel-shaped passage (*infundibulum*) with the frontal sinus and the anterior ethmoidal cells ; and near its middle is a small oblique aperture, about the size of a crow-quill, which leads into the cavity of the upper jaw.

Lower
meatus.

The *inferior meatus* (fig. 15) is straighter than the middle one, and occupies the whole width of the included space on the outer wall ; but when the bone is clothed by the mucous membrane the space extends still farther forwards. In its front is the opening of the ductus ad nasum, and nearly on a level with but behind it, the Eustachian tube may be seen.

Fourth
meatus.

Occasionally there is a small fourth or rudimentary meatus above the rest, which communicates with a posterior ethmoidal cell.

Nares.

The *nares*. In the recent condition of the nose each fossa has a distinct anterior opening in the face, and another in the pharynx ; but in the skeleton there is only one common opening in front for both sides. These apertures, and the parts bounding them, have been before described (p. 32 and 134).

Mucous
lining of the
nose.

The *mucous membrane* that lines the nasal fossa is called the pituitary or Schneiderian membrane. It is continuous with the integument at the nostril, and with the membrane lining the pharynx through the posterior opening : moreover, it is also continuous, by means of the openings into the nasal cavity, with the mucous membrane of the tympanum and eyeball, and with that of the different sinuses, viz. frontal, ethmoidal, sphenoidal, and maxillary.

Differs on
spongy
bones and in
sinuses.

In the lower region of the nose, where the air chiefly passes to the lungs, the membrane is thick, and closely united to the subjacent periosteum and perichondrium, and on the margins of the spongy bones it is projected somewhat by the large submucous vessels, so as to increase the extent of surface ; but in the canals and sinuses it is very thin. Near the nostril it is furnished with papillæ, and small hairs (*vibrissæ*).

Some fora-
mina closed.

The foramina in the dry bones, which transmit nerves or vessels, are entirely closed by the membrane, viz. incisor, sphenopalatine, and the holes in the cribriform plate ; but

the apertures that lead to the sinuses and the orbit are only somewhat diminished by the lining they receive : the membrane is partly stretched over the opening of the ductus ad nasum, forming a flap or valve to diminish the aperture.

From the close connection of the mucous membrane with the periosteum, the lining membrane of the nose is sometimes called a fibro-mucous structure.

The surface is covered by the apertures of muciparous glands, which are in greatest abundance, and of largest size, about the middle and posterior parts of the nasal fossa (fig. 15). In the lower part of the nose, and in the sinuses, its epithelium is of the columnar ciliated kind, which becomes laminated or scaly near the nostrils. The lining membrane has special characters in the upper or olfactorial part of the cavity,

Olfactory region (fig. 16).^{*}—This is the part of the nose in which the olfactory nerve is distributed, and it is therefore the seat of the sense of smell. Its mucous lining differs much from that in the lower portion of the nose.

This region is situate at the top of the nasal cavity, and is confined to the surface of the roof formed by the cribriform plate of the ethmoid bone ; to a portion of the outer wall constructed by the upper, and part of the middle spongy bone ; and to a corresponding extent of the septum, viz. about one third.

The epithelium, *a* to *c*, of the mucous membrane covering this region is of a brownish tint, is laminar, and is composed of many strata.[†] The glands of the part resemble further

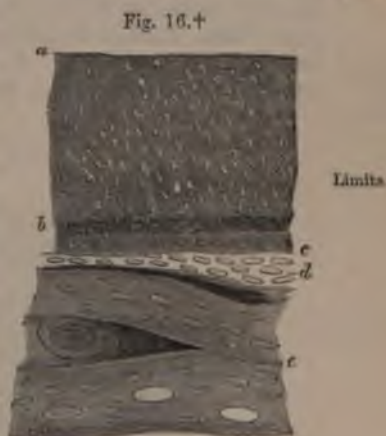


Fig. 16.†

Limits

^{*} This region has been specially described in the third part of the *Physiological Anatomy* of Dr. Todd and Mr. Bowman.

[†] Vertical section of the mucous membrane of the olfactory region in the rabbit (Todd and Bowman). *a* to *c*. Laminated epithelium. *d*. A nucleated subjacent tissue. *e*. An offset of the olfactory nerve.

[‡] Other observers state that the epithelium is elongated or cylindrical, and ciliated at spots.

those of ordinary sweat glands in their position, and in the length and condition of the excretory tubes.

Dissection
of nerves
and vessels.

Dissection.—By the time the student has arrived at this stage of the dissection, little will be seen of the distribution of the olfactory nerve. If the septum nasi be removed, so as to leave entire the membrane covering it on the opposite side (the left), the filaments of the nerve will appear on the surface, near the cribriform plate. On the membrane too, near the front of the septum, is a branch of the nasal nerve. At the same time the naso-palatine nerve and artery may be seen lower down, being directed from behind forwards, towards the anterior palatine fossa. By cutting through the fore part of the membrane that has been detached from the septum, other branches of the olfactory nerve may be traced along the outer wall of the nasal fossa.

Olfactory
nerve

The OLFACTORY NERVE forms a bulb on the cribriform plate of the ethmoid bone, and sends branches to the olfactory region of the nose through the apertures in the roof. These branches are about twenty in number, and are divisible into three sets. An inner set descend in the grooves on the septum nasi (fig. 17), and then branching,

is distri-
buted to
half of
septum,

Fig. 17.*



the roof,
and two
spongy
bones.

extend over the upper half. A middle set is confined to the roof of the nose. And an external set is distributed on

* Nerves of the septum of the nose (Scarpa). 1. Olfactory bulb and its ramifications on the septum. 8. Naso-palatine nerve from Meckel's ganglion.

the two upper spongy bones, and on the flat surface of the ethmoid bone in front of them. As the branches of the olfactory nerve leave the skull, they receive tubes from the dura mater and pia mater, which are lost in the tissue to which the nerves are distributed. The nerves ramify in the pituitary membrane, and form tufts of filaments that communicate freely with the contiguous twigs, forming a network, but their mode of termination in the tissue is unknown.

The olfactory nerve differs in structure from the other cranial nerves; its branches are deficient in the white substance of Schwann, are not divisible into fibrillæ, and are nucleated and granular in texture (fig. 16). They resemble the gelatinous fibres, and seem to be formed of an extension of the nervous matter of the olfactory bulb.—(Todd and Bowman.)

The other branches of the nerves, together with the vessels which are found in the nose, will be described in the following section.

SECTION XIV.

SPHENO-PALATINE AND OTIC GANGLIA, FACIAL AND NASAL NERVES, AND BRANCHES OF THE INTERNAL MAXILLARY ARTERY.

Branches of Meckel's ganglion.—From the ganglion of Meckel in the sphenomaxillary fossa, branches are furnished to the nose through the sphenopalatine foramen, to the palate through the canals of the same name, and to the facial nerve along the vidian canal. The position of these several nerves may first be ascertained by examining their channels of transmission in the prepared skull.

Dissection.—The branches of the ganglion that enter the nose will be found on the left part of the sawn skull, by seeking them opposite the sphenopalatine foramen, through which they enter the nasal fossa with corresponding arteries. One of these nerves (naso-palatine), before referred to as lying in the membrane of the septum, is to be isolated from the pituitary membrane, and followed forwards to where it enters the floor of the nose. Branches of the internal maxillary artery accompany the nerves, and are to be dissected with them.

Structure.

Branches of Meckel's ganglion;

Seek branches to the nose,

branches to
the palate ;

body of
ganglion ;

vidian
nerve.

Ganglion of
Meckel.

Situation
and connec-
tion with
spheno-
palatine
branches.

To lay bare the nerves which descend to the palate, the posterior part of the mucous membrane detached from the septum of the nose, and that lining the nasal fossa behind the spongy bones, should be taken away. After this has been removed the palatine nerves and vessels will be seen through the thin translucent palate bone, and will be readily reached by breaking carefully through the bone with a chisel. Afterwards the tube of membrane that contains the vessels and nerves is to be opened ; and these are to be followed down to the soft palate and roof of the mouth, and then onwards towards the incisor teeth. The palatine nerves will lead upwards to the ganglion, which is close to the body of the sphenoid bone. But to bring the ganglion fully into view, it will be necessary to saw through the overhanging part of the sphenoid bone, to cut away pieces of the bones surrounding the hollow in which it lies, and to remove with care the enveloping fat and the periosteum. The ganglion may be then seen to be a small reddish-looking body, from which the vidian nerve passes backwards.

To trace backwards the vidian branch to the carotid plexus and the facial nerve, the student must lay open the canal which contains it in the root of the pterygoid process ; and in doing this he must be careful of a small pharyngeal branch of nerve and artery that are superficial to the vidian, and lie in the pterygo-palatine canal. At the back of the pterygoid canal, a small branch from the vidian to the carotid plexus is to be looked for. Lastly, the vidian nerve is to be followed into the skull by cutting away the point of the petrous part of the temporal bone, and the internal carotid artery ; and is to be pursued on the surface of the temporal bone, beneath the ganglion of the fifth nerve, to the hiatus Fallopii. Its junction with the facial nerve will be seen with the dissection of that nerve. It is rather a troublesome task to trace the nerve beyond the cartilage in the foramen lacerum (basis cranii).

The SPHENO-PALATINE GANGLION (fig. 18, *) (ganglion of Meckel) occupies the spheno-maxillary fossa, close to the spheno-palatine foramen, and is connected with the branches of the superior maxillary nerve to the palate. The ganglionic mass is somewhat triangular in form, and of a greyish colour. It is situate, for the most part, behind the branches of the superior maxillary nerve to the palate, so as to surround only part of their fibres ; and it is prolonged posteriorly into the vidian nerve. Meckel's ganglion resembles the

other ganglionic masses in connection with the fifth nerve in having sensory, motor, and sympathetic offsets or roots connected with it, and in this wise :—its sensory fibres come from the superior maxillary trunk of the fifth nerve, its motor fibres from the facial nerve through the vidian branch, and its sympathetic fibres are continued from the carotid plexus through the sheath of the vidian.

The *Branches* of the ganglion are directed upwards to the orbit; downwards to the mouth; inwards to the nose; and backwards to the pharynx, and to the facial and sympathetic nerves.

Branches to the orbit.—These are two or three in number, which ascend through the spheno-maxillary fissure, and end in the periorbitum. It will be necessary to cut through the sphenoid bone to follow these nerves to their termination.

Branches to the palate.—The nerves of the palate, though connected in part with the ganglionic mass, are the continuation of the spheno-palatine branches of the superior maxillary nerve (p. 107). Below the ganglion they are divided into three palatine nerves (large, small, and external), which are distributed to the roof of the mouth, the soft palate and tonsil, and the lining membrane of the nose.

1. The *large palatine nerve* (anterior) (fig. 18, ^a) reaches the roof of the mouth through the largest palatine canal, and extends forwards nearly to the incisor teeth, where it joins the naso-palatine nerve. Whilst in its canal, the nerve furnishes two or more filaments (*inferior nasal*) to the membrane on the middle and lower spongy bones; and, in the roof of the mouth, it supplies the mucous membrane and glands, and gives an offset to the soft palate.

2. The *small palatine nerve* (posterior), 3, lies in the small, and

Fig. 18.*



* Nerves of the nose and palate (Scarpa). *a* and *b*. Soft palate. 1. Olfactory nerve. 2. Nasal nerve of the ophthalmic trunk. 3. Smaller palatine nerve. 4. Meckel's ganglion. 5. Larger palatine nerve. 6. Vidian nerve. 7. External palatine nerve.

smaller canal, and ends inferiorly in the soft palate and the levator palati muscle ; it supplies the uvula and tonsil.

external
palatine.

3. The *external palatine nerve*, 7, is smaller than the other two, and descends in the canal of the same name. Leaving the canal, the nerve is distributed to the velum palati and the tonsil.

Nasal
branches
are

Branches to the nose.—The nasal branches, from three to five in number, are for the most part very small and soft, and pass inwards through the spheno-palatine foramen. One of these is the naso-palatine nerve. Their distribution is mentioned below.

Superior
nasal,

1. The *superior nasal branches* (anterior) are distributed in the mucous membrane on the two upper spongy bones, and a few filaments reach the back part of the septum nasi.

Naso-pala-
tine.

2. The *naso-palatine nerve* (nerve of Cotunnus) (fig. 17,^s) crosses the roof of the nasal fossa to reach the septum nasi, and descends on this partition to near the front. The nerve now enters a special canal by the side of the septum, that of the left side of the body being anterior to the other, and is conveyed to the roof of the mouth, where it lies in the centre of the anterior palatine fossa. Finally, the nerves of opposite sides are united in the mouth, and are distributed in the mucous membrane behind the incisor teeth ; at their distribution they are connected with the great palatine nerves. On the septum nasi filaments are supplied by the naso-palatine nerve to the mucous membrane. To follow the nerve to its termination, the canal in the roof of the mouth ought to be opened.

Branches
backwards
are to
pharynx

The *posterior branches* are two : a pharyngeal branch, and the vidian nerve.

1. The *pharyngeal branch* is very small, and is directed through the pterygo-palatine canal to the mucous membrane of the pharynx near the Eustachian tube, in which it ends.

and the
facial and
sympathetic
nerves
through the
vidian.

2. The *vidian nerve*, 6, passes backwards through the vidian canal, and sends some small filaments, through the bone, to the membrane of the back part of the roof of the nose (*upper posterior nasal branches*). At its exit from the canal, the nerve furnishes a soft reddish offset (*carotid branch*) to join the sympathetic on the outer side of the carotid artery. The continuation of the nerve enters the cranium through the cartilaginous substance closing the foramen lacerum (basis cranii) and is directed backwards in a groove on the surface of the petrous part of the temporal bone, where it takes the name of *large superficial petrosal nerve* (fig. 19, ²). Lastly it is continued through the hiatus

Fallopian, to join the gangliiform enlargement on the facial nerve. Whilst in the temporal bone, the vidian receives a twig from the tympanic nerve.

The vidian nerve may be considered to consist of motor and sympathetic fibres in the same sheath, these being combined here in the same manner as in the connecting branches between the sympathetic and spinal nerves.

Directions.—The student may now direct his attention to the remaining nerves and vessels in the nasal cavity.

Dissection.—The nasal nerve is to be sought in the nose behind the nasal bone, by gently detaching the lining membrane, after having cut off the projecting bone. A branch is given from the nerve to the septum nasi, but probably this and the trunk of the nerve will be seen but imperfectly in the present condition of the part. The terminal branches of the internal maxillary artery in the sphenomaxillary fossa with its veins are to be completely traced out.

The nasal nerve (of the ophthalmic) (fig. 18, ²) has been already seen in the orbit and skull, and at its termination in the face (p. 47); and the part that connects the two through the nose is now to be learned. Entering the nasal fossa by an aperture at the front of the ethmoid bone, the nerve gives a branch to the membrane of the septum of the nose, and is then continued in a groove behind the os nasi to the lower margin of this bone, where it escapes to the surface of the nose.

Branches.—*a.* The branch to the septum divides into filaments that ramify on the anterior part of that partition, and reach nearly to the lower border.

b. One or two filaments are likewise furnished by the nerve to the mucous membrane of the fore part of the outer wall of the nasal fossa; these extend as low as the inferior spongy bone.

Terminal branches of the internal maxillary artery.—The branches of the artery in the sphenomaxillary fossa, which have not been hitherto seen, are the following:—superior palatine, naso-palatine, pterygo-palatine, and vidian.

1. The superior or descending palatine is the largest branch of the artery in the fossa, and accompanies the large palatine nerve in its canal. Arrived at the palate, the vessel is directed forwards in the roof of the mouth, and anastomoses behind the incisor teeth with the artery of the opposite side, and with a branch that descends from the nose through the incisor foramen. In its course the artery supplies branches to the other palatine canals, which pass

Vidian a compound nerve.

Seek other nerves and vessels of nose.

Nasal nerve

lies beneath nasal bone; gives

branch to septum

and to outer wall.

Branches of internal maxillary artery are

palatine branch,

with the contained nerves to the soft palate and tonsil ; and some offsets are furnished to the lining membrane of the nose. In the roof of the mouth the mucous membrane, glands, and gums, receive their vessels from this artery.

nasal
branches,

2. The *nasal* or *spheno-palatine artery* enters the nose through the spheno-palatine foramen, and divides into branches :—Some of these are distributed on the spongy bones and the outer wall of the nasal fossa, and supply offsets to the membrane lining the posterior ethmoidal cells.

one to sep-
tum nasi,

One long branch, artery of the septum (*art. naso-palatina*), runs on the partition between the nasal fossae to the incisor foramen, through which it anastomoses with the superior palatine in the roof of the mouth. This branch accompanies the naso-palatine nerve, and covers the septum with numerous ramifications.

pterygo-
palatine
branch,

3. The *pterygo-palatine* is a very small branch which, passing backwards through the canal of the same name, is distributed to the Eustachian tube and the lining membrane of the pharynx.

vidian
branch.

4. The *vidian* or *pterygoid branch* is contained in the vidian canal with the nerve of the same name, and ends on the upper part of the Eustachian tube and the pharynx after escaping from its canal.

Other nasal
arteries.

Some small *nasal arteries* are furnished to the roof of the nasal fossa by the anterior and posterior ethmoidal branches of the ophthalmic (p. 48) ; and others from the facial artery supply the part near the nostril.

Veins ;

Veins.—The veins accompanying the terminal branches of the internal maxillary artery unite in the spheno-maxillary fossa in the *alveolar plexus*. Into this plexus offsets are received from the pterygoid plexus and the infraorbital vein ; and from it a large trunk (alveolar, anterior internal maxillary vein) is directed forwards below the malar bone to join the facial vein (p. 29). Beneath the mucous membrane of the nose the veins have a plexiform arrangement, which is particularly large over the free margin of the spongy bones.

alveolar
plexus.

Facial nerve.

FACIAL NERVE IN THE TEMPORAL BONE.—This nerve winds through the petrous part of the temporal bone, and it is followed with difficulty in consequence of the extreme density of the bone, and the absence of marks on the surface to indicate its position. To render this dissection easier, the student should be provided with a temporal bone, in which the course of the facial nerve and the cavity of the tympanum are displayed.

Dissection.—The examination of the nerve is to be begun at the stylo-mastoid foramen, and to be carried inwards from that point. With this view, the side of the skull should be sawn through between the meatus externus and the anterior border of the mastoid process, so as to open the posterior part of the aqueduct of Fallopius. The nerve will be then seen entering deeply into the substance of the temporal bone; and it will be readily followed if the dissector cuts away with the bone forceps all the bone projecting above it. In this last step the cavity of the tympanum will be more or less opened, and the chain of bones in it laid bare. The nerve is now to be traced onwards along the inner side of the tympanum, till it becomes enlarged, and bends suddenly inwards to the meatus auditorius internus. The surrounding bone is to be removed from the enlargement on the nerve, so as to trace to it the petrosal nerves; and then the meatus auditorius is to be laid open, to see the facial and auditory nerves in that hollow.

Dissection
of nerve in
the bone,

The course of the chorda tympani nerve (branch of the facial) across the tympanum will be seen by the removal of the central ear bone, the incus. The nerve may be also followed through the wall of the cavity behind, as well as out of the cavity in front.

of chorda
tympani,

The remaining branches of the facial nerve in the bone are very minute, and are not to be seen, unless on a fresh piece of the skull which has been softened in acid. The student may therefore omit all the paragraphs marked with an asterisk, till he is able to obtain a part on which a careful examination can be made.

and other
branches.

The facial nerve enters the internal auditory meatus with the auditory nerve. It is then received into the aqueduct of Fallopius at the bottom of the meatus, and is conducted through the temporal bone to the stylo-mastoid foramen and the face (p. 39). In its serpentine course through the bone, the nerve is first directed outwards to the inner wall of the tympanum: at that spot it suddenly bends backwards, and is marked by a gangliiform swelling (intumescencia gangliiformis) fig. 19, to which several nerves are united. From this swelling the nerve is continued through the arched aqueduct, passing along the inner wall of the tympanum, and then behind that cavity to the aperture of exit from the bone. The branches of the nerve in the bone serve for the most part to connect it with other nerves; but one supplies the tongue, and another the stapedius muscle.

Facial nerve

winds
through
temporal
bone,

is marked
by swelling
which
receives
many twigs.

Other
branches.

Connecting branches.—These branches communicate with

Branches

joining nerve the auditory and glosso-pharyngeal nerves; also with two trunks (superior and inferior maxillary) of the fifth nerve.

to auditory nerve, * 1. *Union with the auditory nerve.*—In the bottom of

Fig. 19.*



the meatus the facial and auditory nerves are connected by one or two minute filaments.

to superior maxillary, tympanic, and sympathetic, * 2. *Connecting branches of the gangliform enlargement.*—The swelling of the facial nerve receives three small twigs. One in front is the *large superficial petrosal* nerve (vidian) (fig. 19, ²); another is the *small superficial petrosal* of the tympanic nerve 3; and the third is the *external superficial petrosal* 4, which is derived from the sympathetic on the middle meningeal artery.

to gustatory by chorda tympani. * 3. *Chorda tympani.*—This long but slender branch of the facial nerve crosses the tympanum, and ends in the tongue. Arising about a quarter of an inch from the stylomastoid foramen (fig. 19, ³), the nerve is directed forwards to the tympanum through a canal in the posterior boundary, and enters that cavity below the pyramid. In the cavity the nerve is directed forwards, across the handle of the

* Nerves joining the enlargement of the facial nerve (Bidder). 1. Facial nerve. 2. Large superficial petrosal. 3. Small superficial petrosal. 4. External superficial petrosal. 5. Chorda tympani.



OTIC GANGLION.

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malleus and the membrana tympani, to the Glasserian fissure, or an aperture in the bone on the inner side, through which it leaves the tympanum. Outside the skull the chorda tympani joins the gustatory nerve (fig. 20, 7), and continues along it to the submaxillary ganglion and the tongue (p. 99).

The AUDITORY NERVE will be learned with the ear. It may be now seen to divide into two parts, one of which enters the cochlea, and the other the vestibule. Auditory nerve.

OTIC GANGLION.—At this late period of the dissection, there is little to be seen of this ganglion, but the student should remember that it is one of the things to be examined in a fresh part. Its situation is on the inner aspect of the inferior maxillary nerve, close to the base of the skull, and it must therefore be arrived at from the inner side. Otic ganglion.

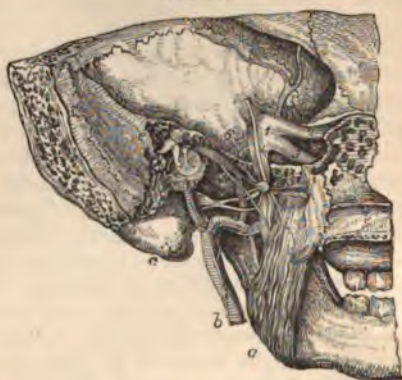
Dissection.—Putting the part in the same position as for the examination of Meckel's ganglion, the dissector should define the Eustachian tube and the muscles of the palate, and then take away the levator palati and that tube, using much care in removing the last. When some loose areolar tissue has been cleared away the internal pterygoid muscle comes into view, with the trunk of the inferior maxillary nerve above it, and a small branch (internal pterygoid) descending from the nerve to the surface of the muscle. If this branch of nerve to the pterygoid muscle be taken as a guide, it will lead to the ganglion. Dissection.

* To complete the dissection, saw vertically through the petrous part of the temporal bone, a little nearer the middle line than the inner wall of the tympanum, the bone being supported whilst it is divided. Taking off now some membrane that covers the ganglion, the student may follow backwards a small branch to the tensor tympani muscle, but he must previously open the small canal that contains the muscle, by entering it from below through the carotid canal. Above this small branch is another minute nerve (small superficial petrosal), which issues from the skull, and joins the back of the ganglion. A small twig is to be sought from the front of the ganglion to the tensor palati muscle, and one, near the same spot, to join the sympathetic nerve on the middle meningeal artery. To define ganglion and its branches.

The OTIC GANGLION (gang. auriculare, Arnold) (fig. 20,) resembles the other ganglia connected with the fifth nerve. It is a small reddish body, which is situate on the inner surface of the inferior maxillary nerve close to the skull, and surrounds the origin of the nerve to the internal ptery- Otic ganglion is on inner side of inferior maxillary.

goid muscle. By its inner surface the ganglion is in contact with the Eustachian tube, and at a little distance behind is the middle meningeal artery. In this ganglion, as in the others above referred to, filaments from motor, sensory, and sympathetic nerves are blended. Some twigs are furnished by it to muscles.

Fig. 20.*



Branches
join it with
fifth,

sympathetic

and tym-
panic
nerves.

Other
branches
enter
muscles.

* *a. Connecting branches—roots.*—The ganglion is joined by a fasciculus from the motor part of the inferior maxillary nerve, and is closely united with the branch of that nerve to the internal pterygoid muscle, thus receiving two of its roots, motor and sensory, from the fifth nerve. Its connection with the sympathetic is established by a twig that is received from the plexus on the middle meningeal artery. Further, the ganglion is connected with the tympanic nerve by means of the small superficial petrosal nerve, 6, which joins the posterior part.

* *b. Branches to muscles.*—Two muscles receive their nerves from the otic ganglion, viz. tensor tympani and circumflexus palati. The nerve to the tensor tympani (fig. 20) is directed backwards, and enters the bony canal that contains that muscle. The branch for the circum-

* Inner view of the otic ganglion (Arnold). *a.* Internal pterygoid muscle with its nerve entering it. *b.* External carotid artery with the sympathetic on it. 1. Gasserian ganglion. 2. Ophthalmic trunk. 3. Superior maxillary. 4. Inferior maxillary trunk with the otic ganglion on it. 5. Branch to tensor of the palate; and opposite to it is the small nerve to the tensor muscle of the tympanum. 6. Small superficial petrosal nerve. 7. Chorda tympani.



THE TONGUE.

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flexus, 5, arising from the front of the ganglion, may be supposed to be derived from the internal pterygoid nerve.

The *nerve of the internal pterygoid muscle* (fig. 20), is a long slender branch, which arises from the inner side of the inferior maxillary nerve near the skull, and is directed downwards to the deep surface of the muscle. This nerve is joined by a fasciculus from the motor root of the fifth nerve.

Directions.—The remainder of the left pterygo-maxillary region may be examined on this side of the body.

Nerve of
internal
pterygoid.

Directions.

SECTION XV.

DISSECTION OF THE TONGUE.

Directions.—The tongue and larynx are to remain connected with each other whilst the student learns the general form, and the structure of the tongue.

Dissection.—The ends of the extrinsic lingual muscles that have been detached, may be cut off, but enough of each should be left to trace it afterwards into the substance of the tongue.

The TONGUE occupies the floor of the mouth, and is rather ovoidal in shape, with the larger end turned backwards. It is free over the greater part of the surface; but at the hinder part, and at the posterior two-thirds of the under surface, it gives attachment to the muscles and the mucous membrane that fix it to the parts around.

The apex or tip of the tongue is in contact with the incisor teeth; and the base, which looks towards the pharynx, is attached to the hyoid bone, and is connected likewise with the epiglottis by three folds of mucous membrane—a central and two lateral. The upper surface or dorsum of the tongue is somewhat convex, and is received into the hollow of the roof of the mouth; in the anterior two thirds it is divided into two equal parts by a median groove, which ends a little in front of a hollow named foramen cæcum. This surface is rough and covered with papillæ over the anterior two thirds; but is smoother at the posterior third, though even here the surface is irregular, in consequence of projecting mucous glands and follicles. The under surface, free only in part, gives attachment to the mucous membrane, and to the different lingual muscles that are connected with the hyoid

Directions.

Dissection.

Tongue.

Situation
and form.

Connections
of apex, and
base.

Upper sur-
face.

Under sur-
face.

	bone and the jaw ; and in front of these muscles is the fold of the mucous membrane named <i>frænum linguae</i> . The
Borders.	borders of the tongue are thick and round at the base of the organ, where they are marked by vertical ridges and furrows, but gradually become thinner near the apex.
Kinds of papillæ ;	<i>Papillæ</i> .—On the dorsum of the tongue are the following kinds of papillæ ; the conical and filiform, the fungiform, and the caliciform.
conical and filiform,	The <i>conical</i> and <i>filiform</i> papillæ are the numerous small projections, like the villi on the mucous membrane of the small intestine, which cover the anterior twothirds of the
situation on front of tongue ;	dorsum of the tongue. Some of the papillæ (conical) are wider at their attached than at their free end, and these are most developed over the central part of the tongue. Others become longer (filiform), especially towards the sides of the tongue. These small papillæ are furnished with minuter papillæ, and are provided at the tip with hair-like processes of the epithelium. Towards their limit behind, as well as on the side of the tongue, they have a linear arrangement.
fungiform	The <i>fungiform</i> papillæ are less numerous but larger than the preceding set, amongst which they are scattered. They are wider at the free end than at the part fixed to the
mostly at tip and sides ;	tongue, and they project beyond the other set ; they are situate mostly at the tip and sides of the tongue. They are covered with small simple papillæ.
caliciform, near root of tongue ;	The <i>caliciform</i> (papillæ vallatæ) are fewer in number and larger than the others, and are placed at the junction of the two anterior with the posterior third of the tongue. Their number varies from eight to ten. These papillæ extend
form ;	across the tongue in a line resembling the letter V. Each papilla consists of a central truncated part of a conical form, which is surrounded by a fold of the mucous membrane : its wider part or base projects above the surface, whilst the apex is attached to the tongue. Both the papilla and the surrounding fold are furnished with smaller secondary papillæ.
Secondary papillæ.	Minute simple papillæ exist in the part of the tongue behind the caliciform kind ; but they cannot be observed till the epithelium is removed.*—(Todd and Bowman.)
Structure of papillæ.	<i>Structure of the Papillæ</i> .—The <i>simple</i> papillæ are con-

* Similar papillæ are said, by Mr. Salter, to occupy "the whole of the under surface of the free portion of the tongue."—*Cyclop. of Anatomy* : art. TONGUE.



STRUCTURE OF THE TONGUE.

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structed like those of the skin, viz. of a projecting cone of formative membrane, which is covered by epithelium, and filled with a loop of the capillaries, and a nerve. The three other *compound* forms of the papillae may be said to be formed by outgrowths from the simple kind. Thus smaller papillary eminences spring from the common cone of limiting membrane; and each has its separate investment of epithelium, by which the brush-like appearance on the surface is produced. From the plexus of capillary vessels in the interior of the papilla a looped offset is furnished to each smaller papillary projection; whilst the entering nerve sends offsets to the different subdivisions of the papilla, whose mode of ending in each is unknown.

STRUCTURE.—The tongue consists of two symmetrical halves, and separating them is a fibrous structure in the middle line. Each half is made up of a mass of muscular fibre with interspersed fat; and entering it are the lingual vessels and nerves. The whole tongue is enveloped by the mucous membrane, and a special fibrous membrane attaches it to the hyoid bone.

Dissection.—By the time the student has arrived at this stage, the muscular fibres may have lost their colour; but with a fresh part the facts here stated can be easily ascertained.

To define the septum, and the membrane attaching the tongue to the hyoid bone, the tongue is to be placed on its dorsum, and, the remains of the mylo and genio-hyoideus having been removed, the genio-hyo-glossi muscles are to be cleaned, and drawn from one another along the middle line. After separating these muscles, except in front, and cutting across their intercommunicating fibres, the edge of the septum will appear; but it will be more completely denuded by cutting through the anterior fibres of the left hyo-glossus. By tracing the hinder fibres of the genio-hyo-glossus muscles towards the os hyoides, the hyo-glossal membrane will be arrived at. At the front of the tongue the genio-hyo-glossus will be afterwards followed out.

Outside this triangular muscle in the middle line, is the longitudinal bundle of the inferior lingualis, which may be cleaned on the left side, though it will be better seen subsequently on the right half.

Fibrous tissue.—Along the middle line of the tongue is a thin lamina of this tissue, forming a septum: at the root is another fibrous structure, named the hyo-glossal membrane; and covering the organ, for the greater part, is a submucous layer of the same tissue.

- its septum. *Septum*.—This fibrous structure forms a vertical partition between the two halves of the tongue, and extends from the base to the apex. It is stronger posteriorly than anteriorly, and is connected behind with the hyo-glossal membrane. To each side the transverse muscle is connected.
- Fibro-cartilage. Its disposition may be better seen subsequently on a vertical section. In some instances a small fibro-cartilage about a quarter of an inch deep and of the same length exists in the septum.
- Hyo-glossal membrane. The *hyo-glossal membrane* is a thin, but strong fibrous lamina, which attaches the root of the tongue to the upper border of the body of the hyoid bone. On its under or anterior surface some of the hinder fibres of the *genio-hyo-glossi* are collected, as if this was their aponeurosis to attach them to the *os hyoides*.
- Sub-mucous aponeurosis. The *submucous fibrous* or aponeurotic *stratum* of the tongue invests the organ, and is continued into the sheaths of the muscles. Over the posterior third of the dorsum its strength is greater than elsewhere; and in front of the epiglottis it forms bands in the folds of the mucous membrane in this position. Into it the muscular fibres are inserted, which end on the surface of the tongue.
- Muscles in each half. *MUSCLES*.—Each half of the tongue is made up of extrinsic and intrinsic muscles. The former are distinguished by having only their termination in the tongue; and the latter, by having both origin and insertion within the organ,—that is to say, springing from one part and ending at another.
- Two kinds. A. The *extrinsic muscles* are the following, viz, palato and stylo-glossus, hyo and genio-hyo-glossus, and pharyngeoglossus. Only the lingual endings of these are now to be noticed, for the origin from the bones around have been before made out.
- Extrinsic; number. *Dissection*.—After the tongue has been firmly fastened on its left side, the extrinsic muscles may be dissected on the right half. Three of these muscles, viz, palato, stylo, and hyo-glossus, come together to the side of the tongue, at the junction of the middle and posterior third; and, to follow their radiating fibres forwards, it will be necessary to remove the mucous membrane from the dorsum and the under surface, between the tip and the point at which they come in contact with the border. On the dorsum of the tongue a thin muscular stratum, which is superficial to those fibres, is to be taken away with the mucous membrane; and beneath the tip a junction between the stylo-glossus muscles of opposite sides is to be traced.
- Dissection of palato stylo- and hyo-glossus.



EXTRINSIC LINGUAL MUSCLES.

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Only the two parts of the *hyo-glossus* (*basio* and *cerato-glossus*, p. 102), which arise from the body and great wing of the hyoid bone, are referred to above. To lay bare its third part, or the *chondro-glossus*, the other two portions of the muscle must be cut through with the lingual vessels, and raised and shown entering the tongue. The origin of this small muscular slip, two or three lines in width, can be now seen close to the small cornu of the *os hyoides*, but it is concealed farther by some fibres of the *genio-hyo-glossus* that ascend to the upper constrictor; and its radiation, near the upper surface of the tongue, will be prepared by taking the mucous membrane and the thin underlying muscular stratum from the remaining third of the dorsum.

The part of the constrictor muscle that is attached to the tongue, and the ending of the *genio-hyo-glossus*, come into view through the division of the *hyo-glossus*.

The *palato* and *stylo-glossus* are partly combined at their attachment to the lateral part of the tongue, and form, together with the following muscle, an expansion that covers the three anterior fourths of the dorsum beneath the superficial lingualis. In this muscular stratum the fibres radiate from the point of contact of the muscles with the tongue—some passing almost horizontally inwards to the centre, and others obliquely forwards to the tip of the organ.

A great portion of the *stylo-glossus* is directed along the side of the tongue, and some fibres are inclined to the under surface in front of the *hyo-glossus*, to join those of the opposite muscle beneath the tip.

Hyo-glossus.—The two superficial parts of the muscle (*basio* and *cerato-glossus*, p. 102) enter the under surface of the tongue, between the *stylo-glossus* and the lingualis. After entering that surface by separate bundles, they are bent round the margin of the tongue, and form, with the two preceding muscles, a stratum on the dorsum, whose disposition and extent have been before stated.

The third part of the muscle, or the *chondro-glossus*, is distinct from the rest at its origin, and is separated from them higher up by a slip of the *genio-hyo-glossus*, and by the lingual vessels. About two or three lines wide at its origin from the root of the small cornu, and from part of the body of the *os hyoides*, the muscle is directed upwards and forwards to the root of the tongue beneath the hinder fibres of the *genio-hyo-glossus*. In entering the tongue the fibres spread out beneath the upper lingualis, passing obliquely inwards and forwards over the posterior third of the dorsum,

Of *hyo-glossus*

Of constrictor muscle.

Combined *palato* and *stylo-glossus*; position and extent. Fibres.

Rest of *stylo-glossus* joins follow.

Hyo-glossus; superficial parts; mode of ending.

Deeper part or *chondro-glossus*.

origin, connections ending in the tongue.

Muscular
cortex of
tongue.

Arrange-
ment in the
tongue ;

its posterior
fibres.

Perpendicu-
lar fibres,

where
present.

Constrictor
at the
tongue,

how ends.

Number and
names of
these.

First com-
plete infe-
rior,

then supe-
rior lingua-
lis, then
transversa-
lis.

and extend as far as the hyo-glossus, with which they become blended.

Cortex of the tongue.—The muscles above described, together with the superficial lingualis, constitute a cortical layer of oblique and longitudinal fibres, which covers the tongue, except below where some muscles are placed, and resembles “a slipper turned upside down.”* This stratum is pierced by the deeper fibres.

The *genio-hyo-glossus* enters the tongue vertically on the side of the septum, and perforates the cortical covering to end in the submucous tissue. In the tongue the fibres spread like the ribs of a fan from apex to base, and are collected into laminae as they pass through the transversalis. The most posterior fibres end on the hyo-glossal membrane and the hyoid bone ; and a slip is continued from them, beneath the hyo-glossus, to the upper constrictor of the pharynx. A vertical section at a future stage will show the radiation of its fibres.

Some *perpendicular* fibres, distinct from those of the *genio-hyo-glossus*, are said by anatomists to occupy more or less of the middle line of the tongue. A few of these appear to be present in the apex of the tongue, where they pass from the upper to the lower surface, and through them the fasciculi of the transverse muscle are transmitted.

The *pharyngeo-glossus* (*glosso-pharyngeus*), or the part of the upper constrictor attached to the side of the tongue, passes amongst fibres of the stylo and hyo-glossus, and entering into the lingual substance, is continued with the transverse muscle to the septum.

B. The *intrinsic muscles* are three in number in each half of the tongue, viz., transversalis, with a superior and an inferior lingualis.

Dissection.—To complete the preparation of the inferior lingualis on the right side, the fibres of the stylo-glossus covering it in front, and those of the *genio-hyo-glossus* over it behind, are to be cut through. The superior lingualis may be shown, on the left side, by taking only the mucous membrane from the upper surface from tip to base. The transversalis may be laid bare on the right side, by cutting away on the upper surface the stratum of the extrinsic muscles already seen ; and on the lower surface, the inferior lingualis and the *genio-hyo-glossus*.

* This apt simile has been used by Mr. Zaglas in an accurate Monograph on the muscular structure of the tongue. See *Annals of Anatomy and Physiology*, Part I., by Mr. Goodsir, Edin. 1850.

The nerves for the supply of the tongue should be traced on the left half as well as the part will admit ; but a separate recent specimen would be required to follow them satisfactorily. Trace the nerves.

The *transversalis* muscle forms an almost horizontal layer in the substance of the tongue from base to apex. The fibres are attached internally to the side of the septum, and are thence directed outwards, the posterior being somewhat curved, to their insertion into the side of the tongue. Its fibres are collected into vertical plates, so as to allow the passage between them of the ascending fibres. This is horizontal.
Attachments.
Fibres.

The *superior lingualis* (noto-glossus of Zaglas) is a thin layer of oblique and longitudinal fibres close beneath the submucous tissue on the dorsum of the tongue. Its fibres arise from the frenum epiglottidis, and from the fascia along the middle line ; from this attachment they are directed obliquely outwards, the anterior becoming longitudinal, to the margin of the tongue, at which they end like they began. This is the most superficial lingual muscle, and assists in forming the cortex. This is superficial.
Origin.
Fibres.
Ending.

The *inferior lingualis* is much stronger than the preceding, and is placed below the tongue between the hyo and genio-hyo-glossus. The muscle arises posteriorly from the fascia on the dorsum, near the root of the tongue ; and the fibres are collected into a roundish bundle in the position before noted. From its attached surface fasciculi are continued vertically through the transverse fibres upwards to the dorsum ; and at the anterior third of the tongue, where the muscle is overlaid by the stylo-glossus, some of the fibres are applied to that muscle and distributed with it. Position below tongue.
Origin.
Ending.

The *mucous membrane* is a continuation of that lining the mouth, and is provided with a laminar epithelium : partly investing the tongue, it is reflected off at different points in the form of folds (p. 139). At the epiglottis are three small *glosso-epiglottid* folds, connecting this body to the root of the tongue ; the central one of these is called the *frenum* of the epiglottis. Like the membrane of the mouth, it is furnished with numerous muciparous glands, and some follicles. Mucous membrane ; its epithelium.

The *follicles* occupy the dorsum of the tongue, especially between the papillæ vallatæ and the epiglottis, where they form a continuous stratum, some projecting under the mucous membrane. Follicles.

The *glands* (lingual) are racemose or compound in structure, similar to those of the lips and cheek, and are placed beneath the mucous membrane and follicles, covering chiefly the and glands at the base.

posterior third of the dorsum of the tongue. A few are found in front of the caliciform papillæ, where they project into the muscular substance. Some ducts open on the surface, and others into the hollows around the large papillæ, or even into the foramen cæcum.

glands at
the side,
and beneath
tip.

Opposite the papillæ vallatæ, at the margin of the tongue, is a small collection of submucous glands. Under the tip of the tongue, on each side of the frænum, is another collection of the same kind of glands imbedded in the muscular fibres, from which several ducts issue.

Nerves from
three
sources,

NERVES.—There are three nerves distributed in each half of the tongue, viz., the gustatory, the hypoglossal, and the glosso-pharyngeal.

gustatory,

1. The *gustatory nerve* gives upwards filaments to the muscular substance, and to the two smallest sets of papillæ, conical and fungiform; it joins also the hypoglossal nerve.

hypo-glos-
sal,

2. The *hypoglossal nerve* is spent in long slender filaments that are furnished to the muscular substance of the tongue.

and glosso-
pharyngeal.

3. The *glosso-pharyngeal nerve* divides into two branches near the border of the tongue:—One turns to the dorsum, and ends in the mucous membrane behind the foramen cæcum. The other passes beneath the side of the tongue, and divides into filaments that enter the muscular substance; it supplies the papillæ caliciformes, as well as the mucous membrane covering the lateral part of the tongue.

Arteries and
veins.

VESSELS.—The arteries are derived chiefly from the lingual artery of each side; these, together with the veins, have been examined (p. 103). After supplying the muscular substance the vessels enter the papillæ, and end in loops as before said.

SECTION XVI.

DISSECTION OF THE LARYNX.

Outline of
larynx.

The LARYNX is the upper dilated part of the air tube, in which the voice is produced. It is constructed of several cartilages united together by ligamentous bands; of muscles for the movement of the cartilages; and of vessels and nerves. The whole is lined by mucous membrane.

Dissection.

Dissection.—The tongue may be removed from the larynx by cutting through its root, but this is to be done without

injuring the epiglottis. The parts to be learnt would be much better seen on a fresh larynx.

Occupying the middle line of the neck, the larynx is placed in front of the pharynx, and between the carotid vessels. It is pyramidal in form. The base is turned upwards, and is attached to the hyoid bone; and to it the epiglottis is connected. Whilst its apex is directed downwards, and is continuous with the trachea. The front is prominent along the middle line of the neck; and the posterior surface is covered by the mucous membrane of the pharynx. The larynx is very moveable, and during deglutition is elevated and depressed by the different extrinsic muscles which are connected with it and the hyoid bone.

Situation and connections.

Is very moveable.

MUSCLES.—The special muscles of the larynx pass from one cartilage to another, and modify by their action the state of the vocal apparatus. Commonly six muscles are described, but the number is stated differently by anatomists. Three are outside the cartilages, and three are more or less concealed by the thyroid cartilage: they are in pairs with one exception, and are alike on the two sides of the body.

Six special muscles of larynx.

Directions.—On one side of the larynx, say the right, the muscles may be dissected, and on the opposite side the nerves and vessels; and those superficial muscles are to be first learnt, which do not require the cartilages to be cut.

Dissection.—The larynx should be first extended, and when it has been fastened in that state with pins, the dissector may clear away from the os hyoides and the thyroid cartilage the following extrinsic muscles that are inserted into them, viz., the constrictor, sterno-hyoid, sterno-thyroid, and thyro-hyoid. In front, between the thyroid and cricoid cartilages, one of the three small external muscles,—cricothyroid, will be seen. The other two external muscles are situate at the posterior aspect of the larynx: to denude them it will be necessary to turn over the larynx, and to remove the mucous membrane covering it. On the back of the cricoid cartilage the dissector will find the crico-arytenoides posticus muscle; and above it, on the posterior part of the arytenoid cartilages, the arytenoid muscle will appear.

Dissection

of the external set of muscles.

The CRICO-THYROIDEUS MUSCLE is triangular in form, and is separated by an interval from the one of the opposite side. It arises from the front and the lateral part of the cricoid cartilage, and its fibres ascend, diverging from one another, to be inserted into the lower cornu, and the lower border of the thyroid cartilage as far forwards as a quarter of an inch

Crico-thyroideus

is small.

from the middle line ; also, for a short distance (a line), into the inner surface of that cartilage. The muscle rests on the crico-thyroid membrane, and is concealed by the sterno-thyroid muscle.

Crico-arytænoideus posticus

is on back of cricoid cartilage.

The CRICO-ARYTÆNOIDEUS POSTICUS MUSCLE (fig. 21, *b*) lies on the posterior part of the cricoid cartilage. Its *origin* is from the depression on the side of the vertical ridge at the posterior aspect of that cartilage. From this origin the fibres are directed outwards, and converge to be *inserted* by fleshy and tendinous fibres into a projection at the outer part of the base of the arytenoid cartilage.

Musculus Kerato-cricoides (Merkel).—This muscle is a small fleshy slip below and close to the preceding muscle, which arises from the cricoid cartilage, and is inserted into the back part of the lower cornu of the thyroid cartilage.*

Arytænoideus ;

deep or transverse fibres,

superficial or oblique.

Dissection of internal muscles.

The ARYTÆNOIDEUS is a single muscle in the middle line (fig. 21, *s*), and is placed in the concavity on the posterior aspect of the arytenoid cartilages. Two sets of fibres with different directions, viz., superficial and deep, are seen in the muscle. The deep fibres are transverse ; they are inserted into the outer border and the posterior surface of the cartilages, and close the interval between the cartilages. The superficial fibres consist of two oblique fasciculi, which cross like the parts of the letter X, each passing from the base of one cartilage to the apex of the other. A few of the oblique fibres of the muscle are usually continued round the cartilage to join the thyro-arytenoid muscle, and the depressor of the epiglottis.

Dissection.—To bring into view the remaining muscles, which are somewhat concealed by the thyroid cartilage, it will be necessary to remove the right half of the thyroid, by cutting through it near the middle line, after its lower cornu has been detached from the cricoid cartilage. By the removal of a little areolar tissue, the dissector will define inferiorly the lateral crico-arytenoid muscle ; above it, the thyro-arytænoideus muscle ; and still higher, the thin mus-

* A series of observations has been made on this muscle by Dr. Turner, Demonstrator of Anatomy in the University of Edinburgh. He found the muscle seven times in thirty two bodies ; and in one instance it was present on both sides, although Dr. Merkel asserts that it is an "unsymmetrical muscle," and "exists only on one side."—See *Remarks on the Musculus Kerato-cricoides*, by Wm. Turner, M.B. in the *Edinb. Med. Journal* for Feb. 1860.

cular fibres (depressor of the epiglottis) in the fold of mucous membrane between the epiglottis and the arytaenoid cartilage.

Fig. 21.*



The CRICO-ARYTÆNOIDEUS LATERALIS is a small lengthened band, which *arises* from the lateral part of the upper border of the cricoid cartilage; its fibres are directed backwards to be *inserted* with the thyro-arytaenoid muscle, into a projection on the outer side of the base of the arytaenoid cartilage, as well as into the contiguous part of the cartilage on the anterior or outer aspect. This muscle is concealed by the crico-thyroides, and its upper border is contiguous to the succeeding muscle.

Lateral
crico-arytaenoides

is beneath
thyroid
cartilage

The THYRO-ARYTÆNOIDEUS MUSCLE extends backwards in the interior of the larynx from the thyroid to the arytaenoid cartilage; it is thick below, but thin and expanded above. The muscle *arises* from the thyroid cartilage near the middle line, for about the lower half of the depth, and from the

Thyro-arytaenoides.

* Back of the larynx and wind-pipe (Quain's Anatomy). *h*, hyoid bone; *a*, arytaenoid cartilage; *e*, epiglottis; *t*, thyroid cartilage; *c*, cricoid cartilage; *r*, trachea; *b*, crico-arytaenoides posticus; *s*, arytaenoides; *n*, muscular layer at the back of the trachea.

Some fibres ascend to tip, others go to base of arytaenoid cartilage. Connections. crico-thyroid ligament. The fibres are directed backwards with different inclinations ;—The external ascend somewhat, and are inserted into the upper part of the outer surface of the arytaenoid cartilage, and blend with the depressor of the epiglottis. The internal and lower fibres are transverse, and form a thick bundle, which is inserted into the fore part of the base of that cartilage, as well as into the outer surface ; and some fibres are attached to the vocal cord. By its outer surface the muscle is in contact with the thyroid cartilage ; and the inner surface rests on the vocal cords, and on the ventricle of the larynx and its pouch.

Depressor of epiglottis. The DEPRESSOR OF THE EPIGLOTTIS (reflector epiglottidis, thyro-arytaeno-epiglottideus) is the thin muscular layer, which is contained in the fold of mucous membrane bounding laterally the upper opening of the larynx. Its fibres arise posteriorly from the front of the arytaenoid cartilage, but some are continuous below with the oblique fibres of the arytaenoid muscle, and others are derived from the thyro-arytaenoid muscle. From this origin the fibres turn upwards with very different directions, and are inserted into the border of the epiglottis of the same side. The strength of this muscle varies much in different bodies.

Some of the lower fibres of this muscle, which cover the top of the laryngeal pouch, have been described by Mr. Hilton * as a separate muscle, and named by him *compressor sacculi laryngis*.

Parts inside larynx. PARTS INSIDE THE LARYNX.—The laryngeal cartilages are so arranged as to enclose a space, and defend the parts more immediately concerned in the production of the voice, viz., the vocal cords, the glottis, and the ventricle of the larynx and its pouch.

Dissection to expose them. *Dissection.*—For the purpose of displaying the vocal apparatus, let the tube of the larynx be divided along the posterior part ; and in cutting through the arytaenoid muscle, let the incision be rather to the right of the middle line, so as to avoid the nerves that enter it. On looking into the larynx a hollow (ventricle) will be seen on each side ; and if a probe be passed into the hollow or ventricle, it may be made to enter a small pouch by an aperture in the anterior and upper part. The dissector should fill the pouch on the right side by introducing very small and round bits of cotton wool into it. Bounding the ventricle above and below are the bands of the vocal cords.

* See No. 5 of Guy's Hospital Reports.

The *laryngeal space* reaches from the aperture behind the epiglottis to the lower border of the cricoid cartilage. The upper part of the space, corresponding with the large interval between the alæ of the thyroid cartilage, is much diminished in size by the thyro-arytænoid muscles and the vocal cords, and only a narrow interval, the glottis, is left at one spot. At the lower part however the space remains of the same shape and size as the cricoid cartilage, and is therefore circular, and larger than the narrow part before alluded to.

Space partly filled,

producing glottis.

The rest large.

The *upper orifice* of the larynx (fig. 21) will be seen by placing in contact the surfaces of the cut along the posterior part. It is triangular in shape, with the base in front and the apex behind, and its sides are sloped obliquely downwards in the antero-posterior direction. Its boundaries are,—the epiglottis in front, the arytænoid muscle and cartilages behind, and the aryteno-epiglottidean fold of mucous membrane on each side. This aperture is closed by the epiglottis during deglutition.

Upper orifice

shape,

and boundaries.

The *glottis*, or *rima glottidis*, is the interval between the lower vocal cords; it is placed on a level with the base of the arytænoid cartilages, and is the narrowest part of the laryngeal cavity. In the state of rest it is a narrow fissure enlarged a little and rounded behind; but when dilated it is triangular in form, like the upper orifice, though its wider part is turned backwards to the arytænoid muscle. Its sides are not constructed wholly of a yielding material, but partly of ligament and partly of cartilage:—thus, for about the two anterior thirds is the elastic vocal cord, whilst at the posterior third is the smooth inner surface of the arytænoid cartilage. The size of the interval differs in the two sexes. In the male it measures from before back nearly an inch (less a line), and across at the base when dilated, about a third of the other measurement. In the female the dimensions will be less by two or three lines.

Glottis, position,

form, construction,

size differs.

Alterations in the size and form affect the interval where it is bounded by the cartilages, as well as where it is limited by the ligament. In the former part, the changes are occasioned mostly by the rotation of the arytænoid cartilages around their axis; but in the latter they are due to the lengthening or shortening of the bands, or to their yielding, as in the passage of an instrument. In the living body the muscles are constantly producing alterations in the fissure, some acting more immediately on the cartilages so as to be dilators or contractors of its base; and others

Changes in size,

in two ways.

Action of the muscles,

on base, acting on the ligaments, and thereby elongating and shortening the sides. The base is enlarged, and the interval rendered triangular by the posterior crico-arytænoid; and is diminished by the arytænoid, and the lateral crico-arytænoid. And the ligamentous sides are elongated and made tense by the crico-thyroid, but are shortened by the thyro-arytænoid. In inspiration the fissure is slightly larger than in expiration.

Ventricle. The *ventricle* of the larynx (fig. 22, *v*) is the oval hollow, Situation. on each side, between the vocal cords. The upper margin

Fig. 22.*



Parts
around.

of the opening is semilunar, and the lower is straight. On the outer surface are the fibres of the thyro-arytænoid muscle, and in the anterior part is the aperture into the laryngeal pouch.

* Interior of the larynx with the vocal cords (Hilton). *e*, epiglottis; *a*, arytenoid cartilage; *t*, thyroid, and *c*, cricoid cartilage; *b*, depressor of the epiglottis; *r*, lower or true vocal cord; *v*, ventricle of the larynx, with the false vocal cord above it; *s*, laryngeal pouch.

The *laryngeal pouch* (*sacculus laryngis*) (fig. 22, s) will be best seen by removing, still on the right side, the thyro-arytænoid muscle, and some fibrous tissue that covers it. It is a small membranous sac, half an inch deep and cylindrical in form, which projects upwards between the thyro-arytænoid muscle and the upper vocal cord, and reaches sometimes as high as the upper border of the thyroid cartilage. Its cavity communicates with the front of the ventricle by a narrow aperture, provided mostly with two folds of mucous membrane. On the outer surface are numerous small glands, whose ducts are transmitted through the coats of the sac to the inside. Numerous nerves are distributed over the sac. Its upper part is covered by the muscular slip before referred to (p. 168).

Pouch of larynx.

Form and position.

Surrounding parts.

Dissection.—The mucous membrane should be removed on the right side from the two whitish bands of the vocal cords (thyro-arytænoid ligaments), which bound the ventricle of the larynx above and below. Then the lateral crico-arytænoid muscle, and any fibres that may remain of the thyro-arytænoideus should be taken away.

Dissection.

The *thyro-arytænoid ligaments*, or the vocal cords (fig. 22), are two bands on each side, which are extended from the angle of the thyroid to the arytænoid cartilage,—one forming the upper, the other the lower margin of the ventricle; they are about seven lines long in man, and two less in the woman.

Thyro-arytænoid ligaments.

a. The *inferior ligament* (*chorda vocalis*) (fig. 22, r), is the upper free edge of the crico-thyroid ligament: it is composed of fine elastic tissue, and is almost transverse in direction. Attached in front to the angle of the thyroid cartilage, about half way down below the notch, the fibres of the ligament are directed backwards parallel to one another, and are inserted into the anterior prominence at the base of the arytænoid cartilage. Internally this band is covered only by thin mucous membrane, and projects towards its fellow into the cavity of the larynx, the interval between it and the opposite one being the glottis; externally it is connected with the thyro-arytænoid muscle; and inferiorly it is continuous with the crico-thyroid ligament. The edge that bounds the ventricle is straight and well defined, and vibrates to produce sounds.

Inferior or vocal cord

has these connections.

b. The *upper ligament* (false vocal cord) (fig. 22) is semilunar in form, and is much weaker than the preceding one. It is fixed in front to the angle of the thyroid cartilage, near the attachment of the epiglottis; and behind to the

Upper ligament

is a very slight band. rough outer surface of the arytaenoid cartilage. This ligament contains chiefly white fibrous tissue in its interior, which is continuous with that in the arytaeno-epiglottidean fold of mucous membrane.

Mucous membrane. The *mucous membrane* of the larynx is derived from that investing the pharynx, and is prolonged to the lungs through the trachea. When entering the larynx it is stretched between the epiglottis and the tip of the arytaenoid cartilage, forming the arytaeno-epiglottidean fold on each side of the laryngeal orifice: in this spot it is very loose, and the submucous tissue abundant. In the larynx the membrane lines closely the cavity, sinks into the ventricle, and is prolonged into the laryngeal pouch. On the thyro-arytaenoid ligaments it is very thin and adherent, allowing these to be visible through it.

Epithelium. A columnar ciliated epithelium covers the surface from the superior vocal cords and the root of the epiglottis, but has different nature. it becomes flattened on the lower cord (Rheiner*). In the small part of the larynx above the line mentioned, the epithelium is of the laminar kind.

Glands. Numerous *racemose glands* are connected with the mucous membrane of the larynx; and the orifices will be seen on the surface, especially at the posterior aspect of the epiglottis. In the edge of the arytaeno-epiglottidean fold there is a little swelling occasioned by a mass of subjacent glands (arytaenoid), and a small fibro-cartilaginous body. None exist over the vocal cords.

Dissection of nerves. *Dissection.*—The course of the laryngeal nerves in the neck has been already traced, and their termination in the larynx may be dissected on the untouched side. For this purpose the other half of the thyroid is to be disarticulated from the cricoid cartilage; and care should be taken of the recurrent nerve, which lies near the junction between the two. The trachea and larynx should be fastened down next with pins, and after the thyroid has been drawn away from the cricoid cartilage, the inferior laryngeal nerve can be traced over the side of the latter cartilage to the muscles of the larynx, and the mucous membrane of the pharynx. Afterwards the superior laryngeal is to be followed to the mucous membrane of the interior of the larynx, and to that of the pharynx. Two communications are to be found between these nerves; one is beneath the thyroid cartilage, the

* In Kölliker's *Manual of Human Microscopic Anatomy*. Lond. 1860.

other in the mucous membrane of the pharynx. An artery accompanies each nerve, and is to be dissected at the same time.

NERVES.—The nerves that supply branches to the larynx, are the superior and inferior laryngeal branches of the pneumo-gastric nerve (p. 118); the former is distributed to the mucous membrane, and the latter to the muscles. Nerves are from vagus.

1. The *inferior laryngeal* nerve (recurrent), when about to enter the larynx, furnishes backwards an offset to the mucous membrane of the pharynx, which joins with filaments from the upper laryngeal nerve. The nerve then passes beneath the ala of the thyroid cartilage, and ends in branches for all the special muscles of the larynx, except the crico-thyroideus. Its small muscular branches are easily followed, but that to the arytenoid muscle passes beneath the crico-arytenoideus posticus. Beneath the thyroid cartilage this nerve is joined by a long offset of the upper laryngeal nerve. Recurrent nerve supplies special muscles except one.

2. The *superior laryngeal* nerve pierces the thyro-hyoid ligament, and gives offsets to the mucous membrane covering the back of the larynx; it furnishes also a long branch beneath the ala of the thyroid cartilage to communicate with the recurrent nerve. The trunk of the nerve then terminates in many branches for the supply of the mucous membrane: Superior laryngeal nerve joins recurrent,
—Some of these ascend in the aryteno-epiglottidean fold of the membrane to the epiglottis, and the root of the tongue. and ends in mucous membrane.
The others, which are the largest, descend on the inner side of the ventricular pouch, and supply the lining membrane of the larynx as low as the vocal cords. One nerve of this set pierces the arytenoid muscle, and appears(?) to supply it.

VESSELS.—The arterics of the interior of the larynx are furnished from the superior and inferior thyroid branches (pp. 75, 84). Arteries

1. The *laryngeal branch* of the *superior thyroid artery* enters the larynx with the superior laryngeal nerve, and divides like it into ascending and descending branches; some of these enter the muscles, but the rest supply the mucous membrane of the epiglottis, and that of the root of the tongue and interior of the larynx. It anastomoses with the following artery both beneath the ala of the thyroid cartilage, and in the mucous membrane of the pharynx. from superior thyroid;

2. The *laryngeal branch* of the *inferior thyroid artery* ascends on the back of the cricoid cartilage, and supplies the mucous membrane of the pharynx and the posterior muscles of the larynx. from inferior thyroid

two sources. 3. Some other twigs from the inferior thyroid artery perforate the crico-thyroid membrane, and end in the mucous lining of the interior of the larynx at the lower part.

Veins end differently. *Veins.*—The vein that accompanies the branch of artery from the superior thyroid, joins the internal jugular or the superior thyroid vein; whilst the vein corresponding with the other artery opens into the plexus connected with the inferior thyroid veins (pp. 84, 127).

SECTION XVII.

HYOID BONE, CARTILAGES AND LIGAMENTS OF THE LARYNX, AND STRUCTURE OF THE TRACHEA.

Dissection. *Dissection.*—All the muscles and the mucous membrane are to be taken away so as to denude the hyoid bone, the cartilages of the larynx, and the epiglottis; but the piece of membrane that joins the hyoid bone to the thyroid cartilage, and the ligaments uniting one cartilage to another, should be left with care. In the aryæno-epiglottidean fold of mucous membrane, a small fibro-cartilaginous body (cuneiform cartilage) should be sought: an oblique projection indicates its position.

Hyoid bone. *The hyoid bone* (os hyoides) is situate between the larynx and the root of the tongue. Resembling the letter U, placed horizontally and with the legs turned backwards, it offers for examination a central part or body, and two side pieces or cornua.

Body of the bone. The body is flattened, and measures most in the vertical direction. Convex in front, where it is marked by a tubercle, it presents an uneven surface for the attachment of muscles; whilst on the opposite aspect it is concave. To the upper border the fibrous membrane (hyo-glossal) fixing the tongue is attached.

Side pieces, large and small. The cornua are two in number on each side (large and small). The *large* cornu continues the bone backwards, and is joined to the body by a surface covered with cartilage. The surfaces of this cornu look somewhat upwards and downwards; and the size decreases from before backwards. It ends posteriorly in a tubercle. The *small* cornu, or appendix, is directed upwards from the point of union of the great

cornu with the body, and is joined by the stylo-hyoid ligament. It is seldom wholly ossified.

CARTILAGES OF THE LARYNX.—There are four large cartilages in the larynx, which are concerned in the production of the voice, viz. the thyroid, the cricoid, and the two arytaenoid. In addition there are some fibro-cartilaginous structures called yellow cartilage, viz. the epiglottis, a capitulum to each arytaenoid cartilage, and on each side a small roundish piece (cuneiform) in the arytaeno-epiglottidean fold of mucous membrane.

In larynx there are four large

and some small cartilages.

The *thyroid cartilage* is the largest of all: it forms the upper part of the larynx, and protects the vocal apparatus as with a shield. The upper part of this cartilage is considerably wider than the lower, and in consequence of this the form of the larynx somewhat resembles a funnel. The anterior part is prominent in the middle line, forming the subcutaneous swelling named *pomum Adami*; but the cartilage is concave behind at the same spot, and gives attachment to the epiglottis and the thyro-arytaenoid muscles and ligaments. The upper border is notched in the centre.

Thyroid cartilage

is convex in front,

concave behind.

The cartilage consists of two square parts or halves, which are united in the middle line. Posteriorly each half of the cartilage has a thick border, which terminates upwards and downwards in a rounded projection or cornu, both of which are bent slightly inwards: of the two, the upper cornu is the longest; but the lower cornu is thicker than the other, and articulates with the cricoid cartilage. The inner surface of each half is smooth; but the outer is marked by an oblique line, which extends from a tubercle near the root of the upper cornu, almost to the middle of the lower border.

Formed of two halves,

each having borders and cornua.

The *cricoid cartilage* is stronger though smaller than the thyroid; it is partly concealed by the shield-like cartilage, below which it is placed, and encircles the cavity of the larynx. It is very unequal in depth before and behind, the posterior part being three times deeper than the anterior, something like a signet ring.

Cricoid cartilage.

Form.

The outer surface is rough, and gives attachment to muscles. At the back of the cartilage there is a flat and rather square surface, which is marked by a median ridge between two contiguous muscular depressions; and on each side immediately in front of the square surface, is a slight articular mark, which receives the lower cornu of the thyroid cartilage. The inner surface is smooth, and is covered by mucous membrane.

Surfaces.

The lower border is almost straight, and is united to the

Borders.

- the upper most uneven. first ring of the trachea by fibrous membrane. But the upper border is irregular in its outline : it is nearly straight posteriorly, opposite the deep part of the cartilage, and this portion is limited on each side by an articular mark for the arytaenoid cartilage ; but in front of that spot the border is sloped obliquely downwards to the middle line. At the middle line behind there is a slight excavation in each border.
- Arytaenoid cartilages. The *arytaenoid cartilages* are two in number, one on each side of the middle line, and are placed on the upper border of the cricoid cartilage, at the back of the larynx. Each cartilage, about half an inch in depth, is pyramidal in shape, and offers for examination a base and apex, and three surfaces.
- Situation and form.
- Base. The base has a slightly hollowed surface behind for articulation with the cricoid cartilage, and is elongated in front by means of a process which gives attachment to the vocal cord.
- Apex. The apex is directed backwards and somewhat inwards, and is surmounted by the cartilage of Santorini. The inner surface is narrow, especially above, and flat ; but the outer is wide and irregular : on this last surface there is a smaller projection at the base which receives the insertion of some of the muscles. At the posterior aspect the cartilage is concave and smooth.
- Three surfaces.
- Two cartilages of Santorini. *Cartilages of Santorini*.—Attached to the apex of each arytaenoid cartilage is the small, conical fibro-cartilaginous body of Santorini (*corniculum capitulum Santorini*), which is bent inwards towards the one of the opposite side. The arytaeno-epiglottidean fold is connected with it.
- Two cartilages of Wrisberg. *Cuneiform cartilages*.—Two other small fibro-cartilaginous bodies, one on each side, which are contained in the arytaeno-epiglottidean folds, have received this name. Each is somewhat elongated and rounded in form, like a grain of rice ; it is situate obliquely in front of the capitulum of the arytaenoid cartilage, and its place in the fold of the mucous membrane is marked by a slight whitish projection.
- Epiglottis. Form and position. The *epiglottis* (fig. 21, e) is single, and is the largest of the pieces of yellow cartilage. In form it is cordate, and it resembles a leaf, with the stalk below, and the lamina or expanded part above. Its position is behind the tongue, and in front of the orifice of the larynx. During respiration it is placed vertically, but during deglutition it assumes a horizontal direction so as to close the opening of the larynx.
- Surfaces. The anterior surface is bent forwards to the tongue, to which it is connected by three folds of mucous membrane ;

and the posterior surface, hollowed from side to side, is convex from above down. To its sides the arytaeno-epiglottidean folds of mucous membrane are united. The lower part is connected by a fibrous band (thyro-epiglottidean ligament) to the posterior surface of the thyroid cartilage, near the notch in the upper border. The epiglottis is further connected to the hyoid bone and the root of the tongue, in front of it, by strong bands of elastic and fibrous tissue. After the mucous membrane has been removed from the epiglottis, the fibro-cartilaginous structure will be seen to be perforated by numerous apertures, which lodge mucous glands.

Between the epiglottis and the hyoid bone is a mass of yellowish fat with some glands, which has been sometimes called the epiglottidean gland.

LIGAMENTS OF THE LARYNX.—The larynx is connected by ligaments with the hyoid bone above, and with the trachea below. Besides there are connecting fibres uniting together the cartilages; and between some of the cartilages synovial membranes exist.

Union of the larynx with the hyoid bone and the trachea.—A thin loose elastic membrane (thyro-hyoid) passes from the thyroid cartilage to the hyoid bone, and a second membrane connects the cricoid cartilage with the trachea.

The *thyro-hyoid ligament* is attached on the one part to the upper border of the thyroid cartilage, and on the other, to the upper border of the hyoid bone, at the posterior aspect. Of some thickness in the centre, it gradually becomes thinner towards the sides, and finally ends in a rounded elastic cord, which intervenes between the extremity of the hyoid bone and the upper cornu of the thyroid cartilage. The superior laryngeal nerve and artery perforate this ligament, and a synovial membrane is placed between it and the posterior surface of the hyoid bone. In the elastic lateral part of the ligament will be found occasionally a small ossific nodule (cartilago triticea).

The membrane joining the lower border of the cricoid cartilage to the first ring of the trachea—*crico-tracheal ligament*, resembles the band joining the rings of the trachea to each other.

Union of the cricoid and thyroid cartilages.—These cartilages are joined in the middle line in front by the crico-thyroid ligament; and on the side, by a capsular ligament around the small cornu of the thyroid cartilage.

The *anterior crico-thyroid ligament* or membrane is yellow

in colour, and is formed mostly of elastic tissue. At its centre it is thick and strong, and is attached to the contiguous margins of the cartilages from which it is named. But on the sides the ligament is thin, and, though still attached below to the cricoid, it leaves the border of the thyroid cartilage and is continued upwards into the chorda vocalis. Some small apertures exist in this membrane for the passage of small arteries into the larynx. This ligament is partly concealed by the crico-thyroid muscle.

and a lateral joint.

The *lateral crico-thyroid* or *capsular ligament*, surrounds the articular surfaces between the side of the cricoid and the lower cornu of the thyroid cartilage. Its fibres are strongest behind. A *synovial membrane* lines the capsule.

Between cricoid and arytenoid

Articulation between the cricoid and arytenoid cartilages.—

This articulation allows of most movement, and the surfaces of the cartilages, which are in contact, are retained by a capsule, and possess a synovial sac.

is a capsule and synovial sac.

The *capsular ligament* is fixed to each cartilage around its articular surface; and one part—*posterior ligament*, is strongest on the inner and posterior aspects. A loose *synovial membrane* is present in the articulation.

Between arytenoid and capitulum.

A kind of *capsule*, with a *synovial sac*, unites the apex of the arytenoid cartilage with the hollowed base of the capitulum of Santorini. Sometimes these cartilages are blended together.

Between thyroid and arytenoid.

The *ligaments* joining the *thyroid* with the *arytenoid cartilages* (thyro-arytenoid) have been already examined as the vocal cords in the interior of the larynx (p. 171).

Two ligaments of epiglottis.

Ligaments of the epiglottis.—A band—*thyro-epiglottidean*, connects the lower part of the epiglottis to the posterior surface of the thyroid cartilage, close to the excavation in the upper border of the latter. Some fibrous and elastic tissues—*hyo-epiglottidean ligament*, connect likewise the front of the epiglottis to the hyoid bone.

Constituents of trachea.

STRUCTURE OF THE TRACHEA.—The air tube consists chiefly of a series of pieces of cartilage (segments of rings) (fig. 21), which are connected together by fibrous tissue. The interval between the cartilages at the back of the tube is closed by fibrous membrane, and by muscular fibres and mucous glands. The trachea is lined by mucous membrane with subjacent elastic tissue.

Cartilages.

Cartilages.—The pieces of cartilage vary in number from sixteen to twenty. Each forms an incomplete ring, which occupies about three-fourths of a circle; and each is convex

Form.



STRUCTURE OF THE TRACHEA.

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forwards, forming the front and sides of the air tube. At the extremities of the trachea, both above and below, the cartilaginous pieces are least constant in size and form; for towards the larynx they increase in depth, whilst the lowest piece of cartilage is shaped like the letter V: at the extremes also of the tube the cartilages may be slit at their ends, or may be blended together. A fibrous tissue is continued from one to another on both aspects, though in greatest quantity externally, so as to incase and unite them, and is extended across the posterior part of the air tube.

Peculiarities.

Cartilages are contained in fibrous tissue..

Dissection.—On removing the fibrous membrane and the mucous glands from between the cartilages at the back of the trachea, the muscular fibres will appear. After the muscular fibres have been examined, they may be cut through to see the elastic tissue and the mucous membrane.

Dissection.

Muscular fibres.—Between the ends of the cartilages is a continuous layer of transverse unstriated fibres (fig. 21, n), which are attached to the truncated ends and the inner surface of the cartilages. By the one surface the fibres are in contact with the fibrous membrane and glands, and by the other with the next structure. Some longitudinal fibres are superficial to the transverse; they are arranged in scattered bundles, and are attached to the fibrous tissue.

Muscular fibres close trachea behind.

The *elastic tissue* forms a complete lining to the tracheal tube beneath the mucous membrane; though at the posterior part, where the cartilages are deficient, it is gathered into strong longitudinal folds. This layer is closely connected with the mucous membrane covering it.

Elastic tissue lines trachea.

The *mucous membrane* of the trachea lines the tube, and resembles that of the larynx in being furnished with a columnar ciliated epithelium. Connected with this membrane are numerous branched mucous glands of variable size. The largest set are found at the back of the trachea, in the interval between the cartilages, where some are placed beneath the mucous membrane with the muscular fibres, and others outside the fibrous tissue: the ducts of the last pass forwards between the muscular fibres to the surface of the mucous membrane. Other smaller glands occupy the front and sides of the trachea, being situate on and in the fibrous tissue connecting the cartilaginous rings.

Mucous membrane, epithelium, and glands.

SECTION XVIII.

PREVERTEBRAL MUSCLES AND VERTEBRAL VESSELS.

Deep
muscles of
spine.

Directions.—On the part of the spinal column that was laid aside after the separation of the pharynx from it, the student is to dissect the deep muscles on the front of the vertebræ.

Dissection.

Dissection.—To dissect the prevertebral muscles, it will be necessary to remove the areolar tissue. The muscles are three in number on each side, and are easily distinguished. The largest one, nearest the middle line, is the longus colli; the muscle external to this, which reaches to the head, is the rectus capitis anticus major; and the small muscle, external to the last and close to the skull, the rectus capitis anticus minor. The smaller rectus muscle is often injured in cutting through the basilar process of the occipital bone.

Longus
colli.

The LONGUS COLLI MUSCLE (fig. 23, ⁶ and ⁷) is situate on the bodies of the cervical and upper dorsal vertebræ, and is

Origin

Fig. 23.*



by two
pieces.

pointed above, but larger below. It consists of two parts—internal and external, the former being vertical, and the latter oblique in direction. The internal part, 7, arises by fleshy and tendinous processes from the bodies of the two upper dorsal, and two lower cervical vertebræ; and the external piece, 6, takes origin from the upper border of the anterior transverse processes (parapophyses) of four cervical vertebræ (sixth, fifth, fourth, and third). Both parts of the muscle are blended above, and the whole is inserted

Insertion.

by four slips into the lower border of the bodies of the four upper cervical vertebræ. Some of the lowest fibres of the

* Prevertebral muscles of the neck and the scaleni muscles—1. Scalenus anticus. 2. Scalenus medius. 2.* Scalenus posticus. 3. Rectus capitis anticus major. 4. Rectus cap. ant. minor. 5. Rectus lateralis. 6 and 7. Longus colli. 8. Intertransverse muscles.

muscle, those which sometimes extend out as far as the head of the first rib, are attached separately by tendon to the anterior transverse processes of one or two of the lower cervical vertebræ. In contact with the anterior surface of this muscle is the pharynx. The inner border is at some distance inferiorly from the muscle of the opposite side, but superiorly only the pointed anterior common ligament of the spine separates the two. The outer border is contiguous to the scalenus, to the vertebral vessels, and to the rectus capitis anticus major muscle.

The RECTUS CAPITIS ANTICUS MAJOR (fig. 23, ²) is external to the preceding muscle, and is largest at its upper end. Its origin is by pointed tendinous slips from the summits of the anterior transverse processes (parapophyses) of four cervical vertebræ (sixth, fifth, fourth, and third); and the fibres ascend to be inserted into the basilar process of the occipital bone, in front of the foramen magnum. The anterior surface of the muscle is covered by the pharynx, and by the carotid artery and the numerous nerves near the base of the skull. This muscle partly conceals the following one. At its insertion the rectus is fleshy, and reaches from the middle line to the temporal bone.

The RECTUS CAPITIS ANTICUS MINOR (fig. 23, ⁴), is a small flat muscle that arises from the anterior transverse process (parapophysis), and partly from the body of the atlas; and ascending is inserted into the basilar process of the occipital bone between the foramen magnum and the preceding muscle, and half an inch from its fellow. The anterior primary branch of the suboccipital nerve lies between the borders of this muscle and the rectus capitis lateralis.

Dissection.—The small intertransversales will come into view when the other muscles have been removed from the front and back of the transverse processes. By tracing towards the spine the anterior primary branch of one of the cervical nerves, the muscles will be readily found, for they are placed on the sides of the nerve. After the muscles and nerves have been examined, the tips of the conjoined transverse processes may be cut off to lay bare the vertebral artery.

The INTERTRANSVERSE MUSCLES (fig. 23, ⁶) are slender fleshy slips in the intervals between the transverse processes. In the neck there are seven pairs—one for each space. The first pair is between the atlas and the axis, whilst the last pair is between the lowest cervical, and the first dorsal vertebra. One set is attached to the anterior, and

Parts in contact with it.

Rectus capitis major. Origin.

Insertion. Connections.

Rectus capitis minor is beneath preceding.

Dissection of intertransversales.

Intertransverse muscles.

Number and attachments.

- the other to the posterior tubercles on the tips of the conjoined transverse processes (diapophyses and parapophyses). Between the muscles, except in the first two spaces, is the anterior primary branch of a cervical nerve; and beneath the posterior muscle is the other primary branch of the same nerve. In the upper intertransverse space the posterior muscle is often wanting; and, in the lowest space, the muscle of the anterior set is smaller than the others, or it may be absent.
- Peculiarities.** *Cervical nerves at their exit from the spinal canal.*—The trunks of the cervical nerves issue from the spinal canal through the intervertebral foramina, with two exceptions, and bifurcate into an interior and a posterior branch.
- Cervical nerves in their foramina give** *The anterior primary branch* passes outwards between the intertransverse muscles, and joins in plexuses in the neck (p. 76).
- anterior** *The posterior primary branch* turns to the back beneath the posterior intertransverse muscle, and the other muscles attached to the posterior transverse processes (diapophyses); it lies close to the bone between the articular processes of the vertebra.
- and posterior branches.** *Peculiarities in the first two.*—The first two nerves leave the spinal canal above the neural arches of the first two vertebræ, and divide at the back of the neck into anterior and posterior branches.
- First two nerves differ** The anterior primary branch of the first or suboccipital nerve has been examined (p. 120). The anterior branch of the second nerve, after perforating the membrane between the neural arches of the first and second vertebræ, is directed forwards outside the vertebral artery, and beneath the intertransverse muscle of the first space, to join the cervical plexus.
- in both anterior and** The posterior primary branches of the first two nerves are described in the dissection of the back.
- posterior branches.** The vertebral artery has been seen at its origin in the neck (p. 73); and its termination will be described with the vessels of the brain. Entering the foramen between the transverse processes of the sixth cervical vertebra (usually), the artery ascends vertically through the corresponding foramina of the other vertebræ; and having passed through the aperture of the atlas, the vessel turns backwards on the neural arch of that bone, and enters the skull through the foramen magnum, after passing beneath the ligament joining the atlas and the occipital bone. In its course through the foramina, the artery lies in front of the anterior trunks of
- Vertebral artery in the foramina of cervical vertebræ.**
- Position to the nerves.**

the cervical nerves, except those of the first and second,—the former of which crosses on its inner, and the latter on its outer side. The vessel is accompanied by a vein and a plexus of nerves of the same name. In its course the artery furnishes small twigs to the surrounding muscles, and to the spinal canal and the contained cord.

A vein, and nerves are with it.

The *vertebral vein* commences by small radicles in the occiput, and in the muscles of the back of the neck, and enters the aperture of the atlas, where it receives sometimes a vein through the posterior condyloid foramen of the occipital bone. Accompanying the artery, the vein traverses the apertures between the transverse processes, and ends in the subclavian vein. In its course it is joined by branches from the internal and external spinal veins; its other branches are described at p. 74.

Vertebral vein

ends in subclavian.

Branches.

The *vertebral plexus of nerves* is derived from the inferior cervical ganglion of the sympathetic. The plexus surrounds the artery, and communicates with the spinal nerves as high as the third or fourth.

Plexus of nerves.

SECTION XIX.

LIGAMENTS OF THE VERTEBRÆ AND CLAVICLE.

Directions.—On the remaining part of the spine, the ligaments that connect the cervical vertebræ to each other and to the occipital bone are to be dissected.

Directions.

Dissection.—Separate the cervical from the dorsal vertebræ by disarticulation. Then remove altogether the muscles, vessels, nerves, and loose areolar tissue and fat from the vertebræ. By sawing through the occipital bone, so as to leave only an osseous ring bounding posteriorly the foramen magnum, the ligaments between the atlas and the occipital bone can be more easily cleaned.

Dissection.

The COMMON LIGAMENTS attaching together the cervical vertebræ are similar to those uniting the vertebræ in other parts of the spine, viz. an anterior and a posterior strong ligament; bands between the laminae and spines; capsular ligaments and synovial membranes for the articulating processes; and an intervertebral ligament between the bodies of the bones.

Common ligaments of a vertebra.

Directions.—These ligaments are first to be learnt; their

These ligaments de-

scribed elsewhere.

preparation and description will be found with the dissection of the ligaments of the spine, at the end of the thorax. But in opening the spinal canal to see the ligaments inside it, the arches of the three highest vertebræ should be left untouched for the present.

Special ligaments

SPECIAL LIGAMENTS unite the first two cervical vertebræ to each other and to the occipital bone: some of these are external to, and others within the spinal canal.

between first two vertebræ and occipital bone.

The *ligaments outside the spinal canal* are thin fibrous membranes, which connect the bodies and arches of the first two vertebræ in front and behind, and join the atlas with the occipital bone at the same aspects. Capsular ligaments surround the articular surfaces of all the bones, but these will be examined more conveniently after the spinal canal has been opened.

Posterior and

a. Union of the atlas with the axis.—The *posterior ligament* (atlo-axoid) (fig. 25, ²) is a thin loose membrane, which is attached by the one margin to the neural arch of the atlas, and by the other to the corresponding arch of the axis.

Fig. 24.*



anterior atlo-axoid:

Below the superficial layer are some deeper and stronger fibres. The second nerve pierces it. The *anterior ligament* (fig. 24, ³) unites the bodies of the first two vertebræ in the same manner as the preceding ligament connects their arches. It is thickest in the middle.

* External ligaments in front between the atlas and axis and the occipital bone (Bourguery). 1. Sawed basilar process. 2. Anterior occipito-atloid. 3. Anterior atlo-axoid. 4. Articulation of the articular processes cut open.

b. Union of the atlas with the occipital bone.—The *anterior* and *anterior ligament* (occipito-atloid) (fig. 24, *) is thin and wide, and passes from the basilar process of the occipital bone in front of the foramen magnum to the body of the atlas. The

Fig. 25.*



middle part of the ligament, which is fixed to the tubercle on the front of the atlas, is much the thickest. The *posterior* and *posterior ligament* (fig. 25, †) is fixed to the occipital bone behind the foramen magnum, and to the neural arch of the atlas. It is thin; and at its attachment to the bone below, the vertebral artery and the posterior primary branch of the suboccipital nerve pass beneath it.

The *ligaments inside the spinal canal* are peculiar in form, and assist to retain the skull in position during the rotatory and nodding movements of the head. Between the occipital bone and the second vertebra are three strong ligaments—a central one, and two lateral or check ligaments; and, moreover, the odontoid process of the axis is fixed against the body of the atlas by a strong transverse ligament.

Dissection.—Supposing the arches of the cervical vertebræ to be removed except from the first three, the arches of these vertebræ are to be sawn through internal to their articular processes. Afterwards the ring of the occipital bone bounding posteriorly the foramen magnum is to be taken away. Lastly, the student should detach the tube of dura

* External ligaments behind between the atlas axis and the occipital bone.—1. Posterior occipito-atloid ligament. 2. Posterior atlo-axoid. 3. Vertebral artery entering beneath the occipito-atloid ligament.

mater from the interior of the spinal canal; and on raising from below the upper part of the posterior common ligament of the bodies of the vertebræ, the central ligamentous band between the occipital bone and the axis (occipito-axoid) will come into view.

Between skull and axis is a thick central band.

a. *Union of the occipital bone with the axis.*—The *central ligament* (occipito-axoidean) (fig. 26, ¹) is a strong, thick band, which is connected with the posterior ligament of the bodies of the vertebræ, and is rather pyramidal in form with the base uppermost. Above it is attached to the basilar pro-

Fig. 26.*



cess on the cranial aspect and near the margin of the foramen magnum, extending as far on each side as the insertion of the check ligaments. From this spot it descends over the odontoid process, and, becoming narrower, is inserted into the body of the axis. Occasionally a bursa is found between the transverse ligament of the atlas and the superficial fibres of this occipito-axoidean ligament which are continued to the second vertebra.

Dissection.

Dissection.—After the removal of the occipito-axoidean ligament, the student should define a strong band, the transverse ligament, which crosses the root of the odontoid process, and sends upwards and downwards a process to the occipital bone and the axis. The upper offset from the transverse ligament may be cut through afterwards for the

* Internal ligament between occipital bone and axis (Bourgiery). 1 and 2. Attachments of the occipito-axoidean ligament.

purpose of seeing the check ligaments, which diverge, one on each side, from the odontoid process, and come from beneath the ascending band of the transverse ligament.

The lateral odontoid or check ligaments (fig. 27, ¹) are two strong bundles of fibres, one on each side: each is

And two lateral or check ligaments.

Fig. 27.*



attached by one end to the rough side of the head of the odontoid process, and by the other to a depression on the inner surface of the condyle of the occipital bone. These ligaments are covered by the occipito-axoidean band; their upper fibres are short and almost horizontal, and the lower are longer and oblique.

Between the lateral bands there is a central odontoid ligament, which connects the tip of the odontoid process to the margin of the basilar process of the occipital bone.

b. Union of the atlas with the axis.—The transverse ligament of the atlas, fig. 28, is a flat, strong, arched band behind the odontoid process, which is attached on each side to a tubercle below the inner part of the articular process of the atlas. This ligament is widest in the centre, and at this spot it has a band of longitudinal fibres connected with its upper and lower margins (fig. 27), so as to produce a cruciform appearance: the upper end of the central band is inserted into the basilar process, and the lower, into the body of the second vertebra. Its surface towards the cord is concealed by the occipito-axoid ligament. This ligament

With a central band.

To fix odontoid process there is a

transverse ligament.

named cruciform.

* Internal ligaments between the occipital bone and the atlas and axis (Bourguery). 1. The left check ligament. 2. The transverse ligament, sending offsets upwards and downwards. 3. Cut end of the occipito-axoidean ligament.

fixes firmly the odontoid process of the second vertebra against the body of the atlas, confining it in a ring (fig. 28).

Fig. 28.*



articular
surfaces,

and two
synovial
membranes.

Capsule and
synovial sac
to articular
surfaces.

When the transverse and check ligaments have been cut through, the tip of the odontoid process will be seen to have two cartilaginous surfaces; one in front where it touches the atlas, the other at the opposite aspect, where it is in contact with the transverse ligament. Two *synovial membranes* facilitate the movements of the odontoid process, one being for the joint between it and the atlas, and the other for the joint between it and the transverse ligament.

Union of the articular surfaces.—The articular surfaces of the occipital bone and atlas are surrounded by a capsular ligament of scattered fibres, which is strongest externally and in front. When the joint is opened, the condyle of the occipital bone will be seen to look somewhat outwards, whilst the hollowed surface of the atlas has an opposite direction. A *synovial membrane* is present on each side.

The articular surfaces of the first two vertebræ are enclosed on each side by a capsule (fig. 24, 4), which is stronger in front than behind. On opening the joint the surfaces of the bones may be perceived to be almost horizontal. On each side there is a separate loose *synovial membrane*.

Joint at
sternal end
of clavicle.

STERNO-CLAVICULAR ARTICULATION.—The internal end of the clavicle is received on a fibro-cartilage, and is retained in position by a capsular ligament, by a band to the first rib, and by another band between the ends of the clavicles.

Dissection.

Dissection.—For the examination of the ligaments of the sterno-clavicular articulation, take the piece of the sternum that was laid aside for the purpose; and should the liga-

* First vertebra with the odontoid process removed from the socket formed by the bone and the transverse ligament. 1. Socket for the odontoid process. 2. Transverse ligament with its offshoots cut. 3. Neural ring of the atlas.

ments have become dry, they ought to be moistened for a short time. The several ligaments will appear after the removal of some fibrous tissue.

Capsular ligament.—This is a thin membranous expansion (fig. 29, ¹), which encases the articular ends of the bones and the fibro-cartilage. It is attached near the articular surface of each bone, and is thinner before than behind. Sometimes the stronger fibres in front and at the back are described as separate ligaments.

The *interclavicular ligament* (fig. 29, ²), extends above the sternum, between the ends of the clavicles. The fibres do not cross in a straight line, but dip into the hollow between the clavicular bones, and are connected with the upper part of the sternum.

The *costo-clavicular ligament* (fig. 29, ³), is a strong short band of oblique fibres between the first rib and the clavicle. Inferiorly it is fixed to the upper surface of the cartilage of the first rib, and superiorly to a tubercle on the under surface of the clavicle near the sternal end. The subclavius muscle is in front of the ligament. Sometimes the clavicle touches the rib, and is provided with an articular surface and a synovial membrane.

The *interarticular fibro-cartilage* (fig. 29, ⁴) will come into view by cutting the ligaments before described, and raising the clavicle. It is flat and almost circular in form, but is thicker at the circumference than the centre. By its upper surface and margin the cartilage is united to the head of the clavicle which is imbedded in it; and by the opposite surface and margin it is inserted into the cartilage of the first rib. At its circumference it joins the capsule of the joint. Sometimes there is an aperture in the centre of the cartilage.

Two *synovial membranes* are present in the articulation, one being on each side of the fibro-cartilage. The sac in contact with the sternum is looser than that touching the clavicle.

Fig. 29.*



* Ligaments of the inner end of the clavicle. 1. Capsule. 2. Interclavicular ligament. 3. Costo-clavicular ligament. 4. Interarticular fibro-cartilage. 5. Ligaments of the second rib with the sternum.

CHAPTER II.

DISSECTION OF THE BRAIN.

SECTION I.

MEMBRANES AND VESSELS.

Position of the brain. DURING the examination of the membranes, the vessels, and the nerves, the brain is to be placed upside down, resting in the coil of a cloth which supports it evenly.

Three meninges. MEMBRANES OF THE BRAIN.—The coverings of the brain (meninges) are three in number, viz. dura mater, pia mater, and arachnoid membrane. The dura mater is a firm and fibrous investment which supports parts of the brain, and serves as an endosteum to the bones. The pia mater is the most internal layer, and is very vascular. And the arachnoid is a thin serous sac, which is situate between the other two.

Dura mater. Besides enveloping the brain, these membranes are prolonged on the cord into the spinal canal, and will be noticed in the dissection of that part. The description of the dura mater will be found at p. 9.

Arachnoid membrane. The ARACHNOID is a thin serous membrane, which lines the inner surface of the dura mater,* and is reflected over the pia mater and the brain. Around the vessels and nerves that intervene between the skull and the brain, the membrane forms sheaths ; these extend a short distance into the several apertures, and then become continuous with the parietal or cranial portion. Like other serous membranes, it forms a sac which contains a lubricating moisture ; and it consists of a parietal and a visceral part.

Parietal part. The *parietal* part is inseparably united to the inner surface of the dura mater, giving it a smooth and polished surface, and is continued in the same manner over the pieces

* The existence of a distinct parietal part to this membrane is denied by Professor Kölliker, *Manual of Microscopic Anatomy*, Lond. 1860.

of that membrane projecting between the different portions of the brain.

The *visceral* part covers the encephalon loosely, especially at the under surface, but it is united to the underlying pia mater by fibrous processes; beneath it there is a considerable interval (subarachnoid space). When it is traced over the brain, the following is the disposition of the serous membrane. On the upper or convex surface of the cerebrum the membrane passes from one convolution to another, without dipping into the intervening hollows; though it lines the great median fissure as low as the extent of the falx. On the lower or under surface of the cerebral mass the arachnoid covers the anterior lobes, and sinks into the median fissure: but farther back there is a space between it and the brain. Still more posteriorly the serous membrane is closely connected to the pons and the under surface of the cerebellum; but between the hemispheres of the little brain there is another interval beneath it, similar to that at the under part of the cerebrum.

Visceral part is not close to brain.

hollow beneath

varies at spots;

The *subarachnoid space*, or the interval between the arachnoid membrane and the pia mater, is larger in one spot than another; and it contains more or less fluid, which has been named cerebro-spinal. This space is largest at the under part of the great brain about its middle, and in the fissure between the hemispheres both of the cerebrum and the cerebellum. If the arachnoid covering is removed from the fissure between the halves of the cerebellum, the aperture of the fourth ventricle will be perceived, by which the cavity in the interior of the brain communicates with the subserous space of both the encephalon and the spinal cord.

it is the subarachnoid space.

The *PIA MATER*, or the vascular covering of the brain, closely invests the different parts of the cranial mass, and dips into the fissures, as well as into the hollows between the surface convolutions and laminae. Besides covering the exterior of the brain, it sends processes into the interior to supply vessels to the walls of the enclosed spaces: thus, one penetrates into the cerebrum below the corpus callosum, and is named *velum interpositum*; and two vascular fringes which project into the fourth ventricle, are known as the choroid plexuses of that cavity.

Pia mater

sends pieces into the brain;

This membrane is a net-work of vessels, and is constructed of the minute ramifications of the arteries entering the substance of the brain, and of the veins issuing from the cerebral substance; whilst the intervals between the vessels are closed by fine areolar tissue, so as to form a continuous

it is a net-work of blood-vessels.

membrane. From the under surface of the pia mater proceed numerous fine vessels for the nutrition of the brain.

Vessels and nerves.

Vessels and nerves.—The arachnoid membrane has but few vessels, whilst the pia mater is composed almost entirely of vessels and nerves. The arachnoid is considered to be nerveless; but the pia mater is largely supplied by offsets of the sympathetic, which accompany the bloodvessels at the base of the brain (p. 21). Bochdalek has also described offsets to the arachnoid from some cranial nerves.

Dissection of the vessels.

Dissection.—To follow out the arteries, let the brain remain upside down, and let the arachnoid membrane be removed from the vessels seen on the surface. First, the two arteries lying in the median fissure of the great brain may be defined; next, the artery that passes outwards transversely between the two lobes of the large brain; and, lastly, a vessel bending backwards along the inner part of the great brain (cerebrum). One artery may be seen ramifying on the upper (in the present position) surface of the little brain, and another is to be followed on the opposite surface.

Subdivisions of the encephalon.—Before entering on the description of the arteries, the chief subdivisions of the encephalon will be shortly mentioned.

Outline of cranial mass.

The cranial or encephalic mass of the nervous system consists of cerebrum or great brain, cerebellum or small brain, and pons and medulla oblongata. Each of these parts has the following situation and subdivisions:—

Upper part of spinal cord.

The medulla oblongata, or the upper end of the spinal cord, lies in the groove between the halves of the small brain, and is divided into two symmetrical parts by a median fissure. To each half some of the cranial nerves are united.

Pons Varolii

The pons Varolii is situate in front of the medulla oblongata, and is marked along the middle by a groove, which indicates its separation into two halves. In front of it are two large processes (crura cerebri) that pass to the great brain; on each side it is united to the small brain by a similar white mass (crus cerebelli); and behind it is the enlarged upper part of the cord.

and its crura.

Cerebellum.

The cerebellum, or the small brain, is divided into two halves by a median fissure, and each half will be subsequently seen to be subdivided into lobes.

Cerebrum

The cerebrum, or the large brain, is also divided into two halves by a longitudinal fissure in the middle line. Each half is further subdivided into anterior, middle, and posterior lobes. Between the anterior and the middle lobe is a

and its great divisions.

sulcus,—the fissure of Sylvius; but the limit between the middle and the posterior is indicated by a line on a level with the anterior part of the small brain. In the centre of the cerebrum, between the hemispheres and in front of the pons, are several small bodies that will be afterwards enumerated.

ARTERIES OF THE BRAIN.—The brain is supplied with blood by the two vertebral, and the two internal carotid arteries. Arteries of the brain.

The VERTEBRAL ARTERY is a branch of the subclavian trunk, and enters the spinal canal beneath the membrane between the atlas and the occipital bone. Ascending then to the brain round the side of the medulla oblongata, the artery enters the skull through the foramen magnum, and is blended with its fellow in one trunk (basilar) at the lower border of the pons. As the vessel winds round the upper part of the cord, it lies between the roots of the hypoglossal and suboccipital nerves; but it is afterwards internal to the former. Vertebral ends in basilar, winds round medulla.

Branches.—Between its entrance into the spinal canal and its termination, each artery furnishes offsets to the spinal cord, the dura mater, and the cerebellum. Branches

1. The *posterior spinal branch* is of inconsiderable size, and arises opposite the posterior part of the medulla: it descends along the side of the cord, behind the nerves, and anastomosing with its fellow, and with branches that enter by the intervertebral foramina. to spinal cord, anterior and

2. The *anterior spinal branch* is as small as the preceding, and springs from the artery opposite the front of the spinal cord. This small branch joins the corresponding twig of the opposite side, and the resulting vessel is continued along the middle of the cord on its anterior aspect. posterior;

3. The *posterior meningeal artery* leaves the vertebral trunk opposite the foramen magnum, and ramifies in the dura mater lining the fossæ of the occipital bone. of dura mater.

4. The *inferior cerebellar artery* (posterior) is distributed to the under surface of the cerebellum. Taking origin from the end of the vertebral, or from the basilar artery, this branch winds backwards round the side of the medulla between the pneumo-gastric and spinal accessory nerves, and enters the median fissure of the cerebellum. Directed onwards along the fissure the artery reaches the upper surface of the small brain, and there anastomoses with the superior cerebellar artery. A branch of this vessel ramifies over the Branch to the under part of cerebellum.

under surface of the cerebellum, and ends externally by anastomosing with the upper cerebellar artery. As the vessel lies by the side of the aperture of the fourth ventricle it gives a small offset to the choroid plexus of that cavity.

Basilar artery.

Extent and situation.

The BASILAR ARTERY is the vessel resulting from the union of the two vertebral arteries. It reaches from the lower to the upper border of the pons, and ends at the last spot by dividing into two branches (posterior cerebral) for the cerebrum. The vessel touches the basilar process of the occipital bone, from that circumstance receiving its name, and lies in the median groove of the pons. On each side of, and almost parallel to it is the sixth nerve.

Branches:

Branches.—Besides the terminal branches, one to each side, mentioned above, the artery supplies transverse offsets to the pons and the under part of the cerebellum, and a large branch to the upper surface of the cerebellum.

transverse to the pons,

1. The *transverse arteries* of the pons are four or six small twigs, which are named from their direction, and are distributed to the substance of the pons. One of these gives an offset to the internal auditory meatus along the seventh nerve. Resembling most this set of branches is the following artery, the *inferior cerebellar* (anterior): this arises from the basilar trunk, and is directed outwards to the fore part of the under surface of the cerebellum, on which it is distributed.

and inferior cerebellar.

Superior cerebellar.

2. The *superior cerebellar artery* is derived from the basilar so near its termination that it is often described as one of the final branches of that vessel. Its destination is to the upper surface of the cerebellum, to which it is directed backwards over the third nerve and the crus cerebri, but parallel with the fourth nerve. On the upper surface of the cerebellum the artery spreads out in branches, and its ramifications anastomose with the vessel of the opposite side, and with the inferior cerebellar artery. Some twigs of this vessel enter the piece of the pia mater (*velum interpositum*), which projects into the posterior part of the cerebrum.

Posterior cerebral artery;

3. The *posterior cerebral artery* takes on each side a backward course, similar to that of the preceding artery, but separated from it by the third nerve. The vessel is then inclined to the inner side of the posterior lobe of the cerebrum, and divides into many branches. Some of these supply the under part of the posterior lobe, whilst others turn upwards on both the outer and inner surfaces of the back of the hemisphere, and anastomose with the other cerebral arteries. Its *branches* are the following :—

a. Numerous small long branches leave it close to its origin, and enter the base of the brain between the crura cerebri (posterior perforated spot). its offsets are

b. Soon afterwards the vessel is joined by a small straight branch (posterior communicating) from the internal carotid artery. communicating

c. Lastly, it furnishes a small *choroid* artery to the fold of pia mater that projects into the cerebrum: this small branch winds round the crus cerebri, and is transmitted between the crus and the hemisphere of the cerebrum to the velum interpositum and the choroid plexus. and choroid.

From the foregoing examination of the offsets of the vertebral arteries, and of the trunk (basilar) that continues them onwards, it appears that about half the encephalon—viz. the medulla oblongata, the pons, the cerebellum, and the posterior third of the cerebrum—receives its blood through the branches of the subclavian arteries. Part of brain supplied by vertebral arteries.

The INTERNAL CAROTID ARTERY terminates in the great brain by supplying branches to the remaining two thirds, or to the anterior and middle lobes. Having passed through the space of the cavernous sinus (p. 21), the vessel emerges on the inner side of the anterior clinoid process, and divides at the inner end of the fissure of Sylvius into anterior cerebral, middle cerebral, and posterior communicating arteries. At the base of the brain the carotid artery lies between the second and third nerves, but nearest the former. Internal carotid ends in cerebral arteries.

Branches.—In the skull the carotid artery supplies the ophthalmic offset, before it ceases in the following terminal branches to the cerebrum. Branches.

1. The *anterior cerebral artery* supplies the inner part of the cerebral hemisphere. The vessel of each side is directed forwards to the median fissure between the halves of the large brain; and as the two are about to enter it, they are united by a short thick artery, the *anterior communicating*. Each artery then runs forwards in the fissure, and bends round the anterior part of the corpus callosum, so as to be placed on the upper aspect in the natural position of the brain. Still continuing backwards nearly to the posterior extremity of the hemisphere, the vessel gives off numerous branches, which anastomose with the other cerebral arteries. It supplies other branches, thus:— Anterior cerebral and communicating artery;

a. Near its commencement the artery furnishes many small branches to the part of the brain contiguous to the its off-sets.

inner end of the fissure of Sylvius (anterior perforated space); and it distributes some branches to the under part of the anterior lobe.

Middle cerebral artery

ends in outer part of hemisphere.

2. The *middle cerebral artery* is the largest offset of the internal carotid, and supplies the outer side of the hemisphere. Passing outwards in the fissure of Sylvius, the artery divides into many large branches, which issue at the outer end of that groove, and spreading over the external surface of the hemisphere of the cerebrum, inosculate with the other two cerebral arteries at the front, the back, and the upper part of the brain. Only a few fine *offsets* require notice :

Offsets.

a. A set of small branches arises at the inner end of the fissure of Sylvius, and enters the cerebral substance through the part called *substantia perforata antica*.

Posterior communicating.

3. The *posterior communicating artery* is a small twig which is directed backwards parallel to and on the inner side of the third nerve, to join the posterior cerebral artery (of the basilar) near the pons.

Choroid artery.

4. The *choroid artery* (anterior) is small in size, and arises either from the trunk of the carotid, or from the middle cerebral artery. It passes backwards on the outer side of the preceding, and finds its way between the hemisphere and the crus cerebri to the choroid plexus of the lateral ventricle.

Circle of Willis;

vessels that take a share in it,

Circle of Willis.—The arteries at the under part or base of the brain are united freely both on their own side and across the middle line, and give rise to an arterial anastomosis, to which the term circle of Willis has been applied. On each side this circle is formed by the trunk of the internal carotid giving forwards the anterior cerebral, and backwards the posterior communicating artery. In front it is constructed by the converging anterior cerebral, and the anterior communicating artery. And behind is the bifurcation of the basilar trunk into the two posterior cerebral arteries. In the area of the circle lie the several parts of the brain corresponding with the floor of the third ventricle.

and the free inosculatation between them.

The complete inosculatation between the cranial vessels in the circle of Willis allows at all times a free circulation of blood through the brain, even though a large vessel on one side should be obstructed.

Veins of the brain.

The **VEINS** of the brain enter the sinuses of the dura mater, instead of uniting into trunks as companions to the arteries.

Dissection.

Dissection.—The pia mater and the vessels are now to be

stripped from the brain, and the origin of the cranial nerves is to be defined. Over the greater part of the cerebrum, the pons, and the medulla, the pia mater can be detached with tolerable facility by using two pairs of forceps ; but over the cerebellum the membrane adheres so closely that it will require some care to remove it without tearing the substance of the brain. In clearing out the fissure between the halves of the cerebellum on the under surface, the membrane that bounds on each side the opening of the fourth ventricle will probably be taken away. The student should therefore observe now the position and size of that opening between the back of the medulla oblongata and the inferior vermiciform process. When the surface has been cleaned, the brain is to be replaced in the spirit till it is hardened,

Care to be taken in removing pia mater.

SECTION II.

ORIGIN OF THE CRANIAL NERVES.

The cranial nerves take origin from the encephalon, with one exception (spinal accessory), and pass from it through apertures in the skull.

The origin of a nerve is not determined by the place at which it appears on the surface of the brain, for fibres or roots may be traced deeply into the nervous substance. Each nerve has therefore a superficial or apparent, and a deep or real origin in the encephalon.

Respecting the superficial attachment to the brain there cannot be any doubt ; but respecting the deep origin there is much difference of opinion, in consequence of the difficulty of tracing the roots. When the roots are followed into the encephalon, they are found to be connected with masses of gray substance, which are looked upon as nerve nuclei, or ganglia of origin.

The cranial nerves may be regarded either as nine or twelve pairs, according to the mode of classifying them.

Those anatomists, who take the smaller number after the example of Willis, include in one nerve all the trunks contained in the same aperture of the skull : as in the case of the eighth nerve, which consists of three trunks in the foramen jugulare. But those who are disposed with Sommerring to enumerate twelve nerves, consider each of the three trunks of the eighth nerve before mentioned, and in like manner all the other trunks issuing from the encephalon, to

is apparent and real.

Real enters gray matter.

Classification as nine or twelve pairs.

constitute a separate cranial nerve, notwithstanding that it may be combined with others in its foramen of exit.

Designa-
tion
from num-
ber,

The several nerves may be designated first, second, third, and so forth : this numerical mode of naming applies to all, and is the one generally used.

name of
part,

But a second name has been given to a few nerves from the parts to which they are supplied ; as instances of this the terms hypo-glossal, pneumo-gastric, may be taken. And a different appellation is given to others, in consequence of the function conferred on the part to which they are distributed, as the terms auditory and olfactory express. In this way two names may be employed, almost indifferently, in referring to a nerve :—one being numerical, the other local or functional, as is exemplified below.

Olfactory
nerve

The FIRST OR OLFACTORY NERVE (olfactory process) (fig. 35, ¹) is very soft and pulpy, being destitute of a neurilemma ; and it may be considered an advanced part of the brain, for it has both gray substance and white fibres in its composition, like the cerebrum.

lies on
anterior
lobe,

The olfactory process is a flat-looking band, wider at each end than in the middle, which is lodged in a sulcus on the under aspect of the anterior lobe of the cerebrum, and is kept in position by the reflection of the arachnoid membrane over it. When the so-called nerve is raised from its sulcus, it is seen to be prismatic in form, the apex of the prism being directed downwards (in this position).

forms ol-
factory
bulb,

Anteriorly the nervous substance swells into the *olfactory bulb*,—a mass of gray matter, which rests on the ethmoid bone, and distributes nerves to the nose. Posteriorly the olfactory process is connected to the cerebrum by three roots of origin, external, internal, and middle.

has external

The *external* or *long root* is a slender white band, which is directed backwards along the outer part of the anterior perforated space, and across the fissure of Sylvius, and disappears by sinking into the substance of the middle lobe of the cerebrum.

internal and

The *internal* or *short root*, not always visible, is also white and delicate, and comes from the inner part of the anterior lobe of the cerebrum.

middle
root.

The *middle* or *gray root* is connected with the gray matter on the surface of the cerebrum by means of a conical elevation at the posterior part of the sulcus which lodges the nerve.

Deep origin.—The external root is said to be connected with one of the convolutions of the island of Reil. The inner root joins a

band of white fibres connected with a convolution (gyrus fornicatus) to be afterwards examined. And the middle root, continuous with the gray matter of the convolutions, contains white fibres which enter the corpus striatum.

The **SECOND** or **OPTIC NERVE** (fig. 35, ²) is the largest of the cranial nerves, except the fifth, and appears as a flat band on the crus cerebri. Anteriorly the nerves of opposite sides are united in a commissure. The part of the nerve posterior to the commissure is named *optic tract*; but the part beyond the commissural union, which is round and firm and invested by a neurilemmar sheath of dura mater, is called *optic nerve*. The destination of the nerve is to the eyeball.

The *tract*, *u*, is the flattened part of the nerve winding round the peduncle of the cerebrum, which is destitute of neurilemma. In front it ends in the commissure, and behind it splits into two parts at its attachment to the brain.

As the tract reaches forwards it crosses the crus cerebri, to which it is attached by its outer or anterior edge; and in front of the crus it is placed between the substantia perforata antica on the outside, and the tuber cinereum on the inside, but whether it receives filaments from the latter is uncertain.

The *commissure* (chiasma) of the optic nerves, *c*, is somewhat of a square shape, and lies on the olivary eminence of the sphenoid bone, within the circle of Willis. It is placed in front of the tuber cinereum; and passing beneath it (in this position of the brain) is the thin lamina cinerea. In the commissure

there is a partial crossing of the fibres of the nerves after this manner:—the outer fibres of each tract, few in number,

Fig. 30.*



Its commissure.

* The superficial attachment of several of the cranial nerves (Bell).—
1. Spinal nerves. 2. Optic nerve. 3. Third nerve. 4. Fourth nerve.
5. Fifth nerve. 6. Sixth nerve. 7. Seventh nerve. 8. Eighth nerve.
9. Ninth nerve.

Arrange-
ment of
fibres.

are continued straight to the eyeball of the same side ; but the greater part of the others decussate,—those of the right nerve being continued to the left side, and *vice versa*, so as to enter the opposite eye. At the front and back of the commissure are some transverse fibres :—the posterior are continued through the optic tracts back to the brain, without entering the eyes ; and the anterior are prolonged to the eyeballs, through the part of the nerve in front of the commissure, but have not any connection with the brain.

Origin from
cerebrum.

The *origin* of the nerve will be afterwards seen to come from two of the corpora quadrigemina (nates and testis of one side), and from the optic thalamus and the corpora geniculata.

Origin of
third nerve

The THIRD NERVE (fig. 30, ³), muscular nerve of the eyeball, is round and firm, and is attached to the inner surface of the cerebral peduncle, near the locus perforatus, and close in front of the pons Varolii.

deep in crus
cerebri.

Deep origin.—The deep origin is uncertain. According to Stilling,* the fibres of the nerve pierce the peduncle, passing through the locus niger, and enter a mass of gray substance in the floor of the aqueduct of Sylvius.

Origin of
fourth nerve
from cere-
bellum,

The FOURTH OR TROCHLEAR NERVE (fig. 30, ⁴) cannot be followed backwards at present to its origin. It is the smallest of the cranial nerves, and springs from the valve of Vieussens over the fourth ventricle. The nerve appears between the cerebrum and the cerebellum, on the side of the crus cerebri (fig. 35, ⁴), and is then directed forwards to enter an aperture in the tentorium cerebelli near the posterior clinoid process.

and Sylvian
aqueduct.

Deep origin.—In entering the valve of Vieussens, the nerves of opposite sides cross. Each then divides into two parts : the anterior enters a nucleus of gray matter on the side of the aqueduct of Sylvius ; the posterior joins a nucleus (upper trigeminal) near the top of the fourth ventricle, and in front of the prolongation of the gray matter of the locus cæruleus (Stilling).

Fifth nerve
has two
roots.

The FIFTH OR TRIGEMINAL NERVE is the largest cranial nerve, and consists of two parts, large and small. This nerve resembles a spinal nerve in possessing two roots, ganglionic or sensory, and a ganglionic or motor, which are blended in part beyond the ganglion.

Origin from
pons,

The nerve is attached to the side of the pons Varolii,

* *Untersuchungen über den Bau des Hirnknotens.*

nearer the upper than the lower border (fig. 30, ²). The small or aganglionic root is highest, and is separated from the other by two or three of the transverse fibres of the pons. Both roots pass outwards through an aperture in the dura mater, above the petrous part of the temporal bone, and are blended in the peculiar manner stated in p. 19.

Both roots penetrate the fibres of the pons, and are connected with nuclei near the floor of the fourth ventricle. near floor of fourth ventricle;

Deep origin.—The large root divides into two parts near the mass of gray matter called locus cæruleus (p. 248). One of these bends downwards to the restiform body. The other, which is smaller, arises from the locus cæruleus, and from the gray matter near it (upper trigeminal nucleus) which the lower part of the trochlear nerve enters; from the gray substance in the floor of the fourth ventricle, near the hypoglossal nucleus; and from a deeper nucleus, lower trigeminal, opposite the lower border of the pons, within the fasciculus teres or the fibres continued from the lateral tract of the medulla (Stillings). beginning of the large root,

The small root begins with the fourth nerve in the upper trigeminal nucleus, which is in front of the prolongation upwards from the locus cæruleus, and anterior to the floor of the fourth ventricle (Stillings). and of small.

The SIXTH NERVE (fig. 30, ³), abducent nerve of the eye-ball, springs from the pyramidal body close to the pons, and by a second band from the lower part of the pons. Origin of sixth nerve.

Deep origin.—The fibres of the nerve bend backwards, through the medulla oblongata, to a nucleus in the floor of the fourth ventricle, whose position is on the outer part of the fasciculus teres, and close behind the anterior fossa (Stillings). See Anatomy of the Fourth Ventricle (p. 249). from fourth ventricle.

The SEVENTH CRANIAL NERVE (Willis) (fig. 30, ⁴) appears at the lower border of the pons near the restiform body. It consists of two distinct trunks, facial and auditory; the former being the motor nerve of the face, and the latter the special nerve for the organ of hearing. Seventh nerve has two parts.

The facial nerve (portio dura, seventh nerve Sömmerring) (fig. 35, ¹) is firm and round, and smaller than the auditory, internal to which it is placed. It issues from the lateral tract of the medulla, close to the pons, and is connected with the lower border of the pons. Origin of the facial.

The facial nerve receives a small accessory band of fibres from the same part of the medulla (intermediate portion of Wrisberg), which is intermediate between it and the auditory; it is then applied to the auditory nerve, with which it enters the internal meatus. Small accessory piece.

The auditory nerve (portio mollis, eighth nerve, Sömmerring) Auditory part.

ring) (fig. 35, ⁷) has a surface attachment to the floor of the fourth ventricle and the restiform body. The nerve is very soft, for it obtains its neurilemma, and therewith its consistence, only in the meatus auditorius.

Deep origin of facial; *Deep origin.*—The *facial nerve* penetrates to the floor of the fourth ventricle, and arises from the same nucleus as the sixth nerve which it joins (Clarke*).

of auditory. The fasciculus of the root of the *auditory nerve* which reaches the floor of the fourth ventricle, bends backwards over the restiform body to the auditory nucleus; and some arciform fibres out of the median sulcus are joined with this part of the root. The other fasciculus pierces the restiform body, and takes origin from a network connected with the outer part of the posterior pyramid (Clarke).

Eighth nerve has three parts.

The EIGHTH CRANIAL NERVE (Willis) (fig. 30, ⁸) is placed along the side of the medulla oblongata, and consists of three distinct trunks, glosso-pharyngeal, pneumo-gastric, and spinal accessory: the names of the first two indicate their destination, and the last, besides being accessory to the pneumo-gastric, supplies some muscles.

Origin of glosso-pharyngeal,

a. The *glosso-pharyngeal nerve* (ninth nerve, Sömmerring) (fig. 35, ⁹) is the smallest of the three, and is situate highest. Its apparent origin is by three or more fibrils, which penetrate the lateral tract of the medulla close to the facial nerve.

vagus,

b. The *pneumo-gastric* or *vagus* (tenth nerve, Sömmerring) (fig. 35, ¹⁰) is connected with the lateral tract of the medulla, below the glosso-pharyngeal nerve, by a series of filaments, which are collected at first into bundles, but are finally gathered into one flat band.

spinal accessory has two parts,

c. The *spinal accessory nerve* (eleventh nerve, Sömmerring) (fig. 35, ¹¹) consists of two parts—accessory to the vagus, and spinal.

accessory,

The *accessory* part is of small size, and arises by fine filaments in a line with the roots of the vagus, as low as the first cervical nerve. Finally this fasciculus throws itself into the pneumo-gastric nerve outside the skull. (See p. 119.)

spinal:

The *spinal* part is firm and round, like the third or the sixth nerve, but only a small piece of it can be seen. It arises by a number of fine filaments from the lateral surface or column of the spinal cord, as low as the sixth cervical nerve; the lowest roots are attached near the lateral fissure and the posterior roots of the nerves, whilst the highest are

* On the Structure of the Medulla Oblongata, by J. Lockhart Clarke, F.R.S. in the Philosophical Transactions for 1858, part i.

attached irregularly and at a distance from the fissure. As the nerve ascends along the side of the cord it lies between the ligamentum denticulatum and the posterior roots of the spinal nerves, with the upper of which it may be sometimes connected; and it finally enters the skull by the foramen magnum.

All three nerves converge to a spot below the crus cerebelli, where they rest on a small lobe of the cerebellum (flocculus). From that spot they are directed outwards to the foramen jugulare (p. 20). all converge in the skull.

The fibrils of the nerves pierce the medulla; and each nerve, except the spinal part of the last, takes origin from a special nucleus at the back of the medulla oblongata, and near the lower angle of the fourth ventricle. (See p. 249.) The deep origin,

Deep origin.—The *glosso-pharyngeal* penetrates as far as the vagus nucleus, where it ends in fibres: some of these enter the vagus nucleus, others join the auditory nucleus, and the rest are directed inwards towards the *raphé*, which they are supposed to join. Deep origin of glosso-pharyngeal;

The *vagus nerve* arises in a special nucleus, but some fibres are directed inwards through a part of the hypoglossal nucleus, and mingle with fibres of the hypoglossal nerve. of the vagus;

The *accessory part* of the *spinal accessory nerve* is transmitted to a special nucleus below that of the vagus, but some fibres are directed forwards and inwards in front of the hypoglossal nucleus to decussate across the middle line with its fellow. The roots of the *spinal part* of the nerve, piercing the lateral column of the cord, pass through a collection of cells on the outer border of the gray crescent in the interior (a continuation upwards of the tractus intermedio-lateralis) in their course to the anterior cornu of the crescent (Clarke). of accessory nerve by two parts, accessory and spinal.

The **NINTH OR HYPOGLOSSAL NERVE** of Willis (twelfth nerve, Sömmerring) (fig. 30, ⁹) is placed on the front of the medulla oblongata, and issues by a series of filaments from the sulcus between the pyramidal and olivary bodies, in a line with the anterior roots of the spinal nerves. Ninth nerve.

The filaments of origin unite into two bundles, which pierce separately the dura mater, and do not blend together till they are outside the cranial aperture. Origin from medulla.

Deep origin.—The filaments of this nerve are traced through the corpus olivare to a nucleus below the level of the fourth ventricle and in front of the canal of the cord, which they enter; but some join the nucleus of the accessory nerve, and others bend inwards to decussate through the *raphé* with the nerve of the opposite side (Clarke). Deep origin from fourth ventricle.

SECTION III.

MEDULLA OBLONGATA AND PONS VAROLII.

The medulla oblongata and the pons are interposed between the spinal cord and the brain proper. In these bodies the constituents of the cord are re-arranged, and increased in volume before they enter the cerebrum and the cerebellum.

Directions.

Directions.—On a single brain the student may ascertain nearly all the anatomy of the parts composing the medulla and the pons ; but if he can procure one hardened specimen of the medulla and the pons united, and another of a vertical section through those bodies, his knowledge will be much more perfect.

Position of the part.

Position.—The brain is to remain in the position in which it was placed during the examination of the nerves and the vessels.

Upper part of spinal cord.

The MEDULLA OBLONGATA is the upper dilated part of the spinal cord which is contained in the cranium (fig. 31). Its

Fig. 31.*



* Anterior view of the medulla oblongata and pons (Quain's Anatomy). *a.* Anterior pyramid. *b.* The decussation. *c.* Olivary



MEDULLA OBLONGATA.

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limit is the lower border of the pons in one direction, and the level of the upper margin of the atlas in the opposite direction. This part of the cord is pyramidal in form, and measures about one inch and a quarter in length, half an inch in thickness, and three quarters of an inch in breadth at its widest part.

The larger part or the base of the medulla joins the pons, the transverse fibres of the latter marking its limit; and the apex is blended with the spinal cord at the spot before mentioned. The anterior surface is irregularly convex, and is in contact with the hollowed basilar process of the occipital bone. The opposite surface is somewhat excavated superiorly, where it forms the floor of the fourth ventricle, and rests in the fissure between the halves of the cerebellum. On the posterior aspect there are not any cross fibres of the pons, as in front, to mark the extent of the medulla.

The medulla oblongata is divided into halves by a median fissure in front and behind. The fissures are in a line with those along the cord, and their extent is influenced by the cross fibres before alluded to on the surface; for whilst the anterior one ceases at the pons in a dilated part (foramen cæcum), the posterior is prolonged behind the pons, and into the groove in the floor of the fourth ventricle.

Each half of the medulla is constituted of the three segments of the spinal cord, which are continued into it; and indications of these are still to be seen on the surface, though the names are changed, and the fibres differently arranged. Thus at the middle line in front is the anterior pyramid corresponding with the anterior column; at the middle line behind is the restiform body with its pyramidal part, continuous with the posterior column; and between these are the fibres of the lateral tract, with an oval projecting body (corpus olivare) on their exterior.

a. The *anterior pyramid* (fig. 31, *a*) is the most internal eminence, and receives its name from its position and form. Situate on the side of the median fissure, it is internal to the olivary body, from which it is separated by a slight groove. Inferiorly the pyramid is continuous with the anterior column of the cord (*g*), and internally it is connected with some decussating fibres from the opposite side across the anterior median fissure (decussation of the pyramids) (*b*). Enlarging as it ascends, this body enters the pons, but, before disappearing,

body. *d.* Restiform body. *e.* Arciform fibres. *f.* Fibres to the restiform body from anterior pyramid. *g.* Anterior column. *h.* Lateral column. *i* and *p.* Fibres of the pons (superficial).

pearing beneath the transverse fibres, it is somewhat constricted and rounded.

Lateral tract

varies in size :

not straight.

Olivary body

does not reach pons.

Some arched fibres.

Different division of the lateral tract.

Restiform body is the largest piece ;

of what parts it consists.

b. Lateral tract and olivary body.—The *lateral tract* (funiculus lateralis) (fig. 31, *h*), continuous with the part of the cord between the attachment of the roots of the nerves (lateral column), fills the interval between the anterior pyramid and the restiform body ; but its width at the surface is not the same throughout. Opposite the lower part of the medulla oblongata, its surface width is equal to that of the other constituent bodies before and behind it ; but near the pons the width is diminished, so that the lateral tract occupies on the surface only the hollow between the outer side of the corpus olivare and the restiform body. Its direction also is not vertical, for it is inclined inwards towards the middle line above, as if it was pushed out of the perpendicular by the projecting olivary body.

The *olivary body* (corpus olivare) (fig. 31, *c*), is the oval projection close to the anterior pyramid. A shallow groove separates it from the pyramid, and a deeper and wider one is between it and the restiform body. This eminence is shorter than the pyramid, and does not reach to the pons. Its upper end is most prominent ; and arching round the lower end and over the surface are some white fibres (fibræ arciformes).

The segment here called lateral tract is divided into three parts by Mr. Clarke, which have the following order from before back :—First, the olivary column (fig. 34, *b*), which surrounds the corpus olivare ; then the lateral column (fig. 34, *c*) ; and close to the restiform body, the gray cornu or column (*f*), a streak of gray matter.

c. Restiform body and posterior pyramid.—The *restiform body* (restis, a rope) (fig. 31, *d*) forms the largest prominence on the half of the medulla oblongata, and cannot be seen satisfactorily except on a distinct preparation. This body is posterior to the lateral tract, and projects laterally, so as to give the greater width to the upper part of the medulla oblongata. The restiform swelling is continuous inferiorly with the posterior column of the spinal cord ; and superiorly it appears to be continued into the pons, like the other segments of the medulla oblongata, but the disposition of its fibres at this spot will be subsequently referred to. Below the level of the olivary body it is divided into two parts by a distinct groove behind ; one of these, the smaller and posterior of the two, is the funiculus gracilis, or the posterior pyramid ; and the anterior and larger part has been named

funiculus cuneatus (Burdach). Between the restiform bodies is the space of the fourth ventricle at the back of the medulla. The *posterior pyramid* (funic. gracilis) is a continuation of that part of the spinal cord which is close to the posterior median fissure. By drawing forwards the medulla, or using a separate piece of hardened medulla, the pyramid will be seen to be slightly enlarged (clava) at the apex of the fourth ventricle, where the restiform bodies diverge, and then to become gradually indistinct along the inner part of the corpus restiforme.

Posterior
pyramid is
close to
posterior
median
fissure.

A little higher than the lower end of the fourth ventricle is a thin lamina of nervous substance on each side (tenia, ligula), which is about a line in width, and forms part of the roof of the fourth ventricle; this membranous piece is attached by one edge to the hinder part of the restiform body, but is free by the other, where it is connected with the vascular fold of the ventricle.

Tenia
of pyramid.

STRUCTURE.—The components of the spinal cord, viz. anterior, middle, and posterior columns, are continued into the lower part of the medulla oblongata, where at first they can be recognised; but they soon become mixed together, and have an arrangement different from that of the cord.

Fibres of the
medulla.

Dissection.—In the pyramid two sets of fibres have to be shown,—one from the same, and one from the opposite side of the cord. The fibres from the opposite half of the cord will appear in the median fissure, when the pyramids are gently drawn from one another, where they are named the decussating fibres; and to lay these bare more completely, the small part of the anterior column of the cord on their side, which remains below the cross fibres (for the cord has been cut through near these), may be forcibly turned outwards. The fibres to the pyramid from the same half of the cord will be demonstrated by everting the anterior column below the decussation, as on the other side.

Dissection
to trace the
pyramid.

The *anterior pyramid* (fig. 32, *b*) receives fibres, inferiorly, from the anterior column of the cord of its own side, and, internally, from the lateral column and the opposite half of the cord. The inner set of fibres are deep at their origin, but they become superficial in the median fissure, and are then directed upwards, close to that fissure, joining the fibres continued from the anterior column; and as the inner fibres of each pyramid are derived from the opposite side, they cross each other in the anterior median fissure of the spinal cord:—thus they form the decussation of the pyramids.

Fibres of
anterior
pyramid.

Derivation

The pyramid is continued into both the cerebrum and

and distri-
bution.

cerebellum. Its fibres are white and longitudinal, and are collected into a bundle of a prismatic form. Superiorly most of the fibres enter the pons (fig. 32), to reach the cerebrum, but two offsets proceed from the outer side:—One is very small and superficial, and is directed below the

Fig. 32.*



corpus olivare to the restiform body and the cerebellum (fig. 31, *f*); the other blends with the fibres of the lateral tract, and invests the olivary body so as to be thickest on the sides, and enters the pons as the olivary fasciculus, or the fillet.

Olivary
body

The *olivary body*, and its *fillet* (fig. 33, *d*, and *c*).—When

Fig. 33.†



the olivary body has been sliced obliquely, it will be seen

* Structure of the medulla and pons (Arnold).—*b*. Anterior pyramids. *x*. The decussating fibres from the left half of the cord. *c* and *d*. Fibres of the lateral column and the olivary body. *m* and *m'*. Superficial and deep transverse fibres of the pons. *n*. Inferior peduncle of the cerebellum, continuous with the restiform body.

† Structure of the pons and the cerebellum (Arnold).—*c*. Olivary

to consist of a thin wavy yellowish layer of gray substance surrounding a centre or nucleus of whitish matter. The zigzag bounding layer is named corpus dentatum. It forms a thin capsule or bag, which is convoluted, and is placed obliquely with the dilated part towards the surface, and the narrowed part or neck open and directed backwards near the raphé. A transverse commissural part unites the olivary bodies across the middle line, as is seen in fig. 34, *g*, where it blends with the raphé, and is close to the anterior median sulcus (Clarke).

Structure.—The bounding layer (fig. 34) is about $\frac{1}{80}$ of an inch thick, and consists of small nucleated and ramified nerve cells, which give origin to fibres.* Longitudinal fibres, continuous with the lateral column, surround and pass through the gray layer (Clarke); and numerous transverse fibres of the arciform system pass by and through it (fig. 34 *h*).

A band of fibres issues from the nucleus through the aperture in the neck of the capsule, and enters the transverse olivary commissure (Clarke) (fig. 34, *g*); whilst other fibres from the front and outer part of the sac unite with the longitudinal fibres around the corpus olivare, and form the olivary fasciculus or the *fillet* which ascends to the cerebrum (fig. 33, *c*).

Dissection.—For the purpose of seeing the arrangement of the fibres of the lateral column and restiform body, the anterior pyramid is to be cut across on the left side, between its decussation and the olivary body, and to be raised together with this body towards the pons. Afterwards the remaining part of the pyramid is to be separated by dividing the fibres it receives from the decussation.

The *lateral tract* of the medulla is continuous inferiorly with the portion of the spinal cord between the anterior and posterior roots of the nerves (fig. 31, *h*), and is prolonged superiorly in greater part to the cerebrum, but it gives an offset to the cerebellum. Soon after entering the medulla oblongata it is divided into three sets of fibres, external, internal, and middle. The external fibres are both super-

fasciculus or the fillet. *d*. Olivary body. *e*. Restiform body. *f* and *g*. Corpora quadrigemina. *h* and *i*. Parts of the fillet. *m* and *m'*. Transverse fibres of the pons. *n*. Inferior peduncle of the cerebellum. *r*. Superior peduncle of the cerebellum.

* The arrangement of the fibres in the sac is most complicated, and a fuller account may be obtained by consulting Mr. Clarke's Paper in the Philosophical Transactions for 1858.

are much mixed in medulla, and pass deeply.

ficial and deep, and, joining the restiform body, reach the cerebellum. The internal offset enters the pyramid of the opposite side. Whilst the middle fibres, the continuation of the column (fig. 33, *t*), ascend beneath the olivary body, and leaving the surface of the medulla at the pons, incline backwards and inwards to the floor of the fourth ventricle (where they form the eminentia teres), in their course to the cerebrum.

Decussation of pyramids formed by lateral columns.

The *decussation of the pyramids* (fig. 31, *b*) is formed chiefly by the crossing of the internal fibres of the lateral columns of opposite sides before they enter the pyramids. This interweaving of the fibres occupies the anterior groove of the medulla oblongata, at the distance of three quarters of an inch from the pons; and it is about a quarter of an inch in length. In it will be found three or four bundles of fibres from each side.

Mr. Clarke's view of the decussation

formed by lateral column, posterior column, and gray substance.

According to Mr. Clarke, fibres enter the decussation not only from the lateral column, but also from the posterior column, and from the central gray substance of the cord:— Thus the fibres from the lateral column, blended with a network of fibres from the contiguous gray substance, form the chief portion of the decussation; whilst the fibres from the posterior column and the adjoining part of the gray substance enter the upper part; and other fibres from the front of the gray matter (anterior commissure) are most conspicuous at the lower part.

Restiform body

enters cerebellum

and cerebrum.

The *restiform body* (fig. 33, *e*) is divided between the cerebrum and the cerebellum. Inferiorly it is continuous with the posterior column of the cord; and accessory fibres are received by it in front from the anterior pyramid, and from the lateral column. Superiorly its fibres are continued to both the large and the small brain in the following manner:— The main part of the restiform body bends outwards to the cerebellum without entering the pons; whilst the inner and smaller part, or the posterior pyramid, is continued along the floor of the fourth ventricle, joining the fasciculus teres of the same side, into the peduncular fibres of the cerebrum (p. 219).

Commissural fibres.

Arched or *commissural fibres* of the medulla.—In each half of the medulla oblongata are fibres directed almost horizontally from behind forwards, both on its exterior, and through its substance. And in the middle line the fibres of opposite sides unite and form a *septum* or commissure between the halves.

Superficial set;

The *superficial transverse fibres* (fig. 34, *s*, and fig. 31)

more or less marked in different bodies, issue from the posterior column, beginning mostly in the nucleus of the beginning restiform body (Clarke), and advance over the surface of the olivary and pyramidal bodies to the anterior sulcus, where

Fig. 34.*



most enter the half of the medulla of their own side, but and ending. others cross the median sulcus to the other half of the medulla, decussating with the fibres of the other side. The fibres that do not reach far into the sulcus join the surface band on the pyramid of the opposite side (Clarke). Below the olivary body this superficial layer forms often times a distinct band, the *fibræ arciformes* (fig. 31, e). Fibræ arciformes.

The *deep transverse fibres* (fig. 34, h) begin behind in the ganglia contained in the posterior pyramid and restiform body (Clarke), and penetrate between the longitudinal fibres as they reach forwards to enter the raphé in the middle line. and ending. Some surround the olivary body, and others traverse it and join with its fibres in the commissure of the olivary bodies. This layer communicates often with the superficial one between the longitudinal bundles of fibres. The two sets join.

The *raphé* (fig. 34, h and g) occupies the middle line of the medulla above the decussation of the pyramids, and serves as the commissure between the olivary bodies and the Raphé. Situation and use.

* Transverse section of the medulla oblongata above the middle of the olivary body (Clarke). a. Anterior pyramid. b and c. Lateral column. d. Restiform body. e. Posterior pyramid. f. Corpus olivare with roots of the ninth nerve piercing it. g. Olivary commissure. h. Deep transverse or commissural fibres of the medulla meeting in the raphé (a few more are added in this cut from a second drawing). i. Accessory olivary nucleus. l. Other gray deposits inside the olivary body. n. Floor of the fourth ventricle covered by epithelium. o. Nuclei of the ninth nerve. p. Nuclei of the vagus and glossopharyngeal nerves. r. Nucleus of the auditory nerve. s. Superficial transverse fibres. t. Remains of the gelatinous substance (tubercula cinerea).

- Fibres decussate. halves of the medulla. As the bundles of fibres enter into it their component threads diverge, decussating with their fellows, and some take an antero-posterior direction along the opposite half of the medulla before they disappear in it. At the top of the medulla the antero posterior fibres are most numerous ; and they receive behind an accession from the auditory nucleus. In this plexus of decussating fibres, are branched nerve cells which join with the other fibres (Clarke).
- Nerve cells.
- Gray matter of the medulla. *Gray matter of the medulla oblongata.*—In the medulla oblongata there are the modified remains of the gray matter in the interior of the spinal cord, and there are in addition some special deposits. Cross sections would be required to see the arrangement completely.
- from two sources.
- Changes in the central gray mass, In the fourth ventricle the gray matter of the cord is laid bare below, in consequence of the restiform and posterior pyramidal bodies being removed from the middle line. It is subjected further to modification, and disappears above amongst the longitudinal fibres.*
- at the lower end of the medulla. At the lower part of the medulla the central gray mass resembles that in the spinal cord (See diagram of the spinal cord), but the transverse piece uniting the crescents is larger, and its central canal is closed by granular matter ; whilst the anterior cornu is thick and club-shaped, and the posterior, long and slender, ends in a tuft of fibres. But it undergoes soon the following changes :—
- In the outer part of the crescent. From the whole outer border of the crescent (in each half) a network of fibres with cells, like the gray substance itself, is prolonged outwards through the lateral column, until the outline of the part becomes undistinguishable.
- In the anterior cornu. The anterior cornu of the crescent is resolved likewise into a network of fibres and cells, which penetrates the lateral column, like the network from the outer border.
- The posterior cornu. The posterior cornu increases in bulk at the same time ; and, as the fibres of the lateral column are directed forwards to the decussation of the pyramids, it extends towards the side of the cord, where it appears on the surface, in front of the restiform body, as the gray tubercle of Rolando (tuberculo cinereo). Finally, in ascending the medulla, it becomes the chief nucleus of the sensory root of the fifth nerve.
- In the gray commissure; From the back of the transverse piece uniting the crescents, close to the median fissure, another network of cells and fibres projects into the posterior pyramid, and forms in it

* This description of the arrangement of the gray matter in the medulla oblongata is a summary of the facts contained in Mr. Clarke's Paper, in the "Transactions of the Royal Society for 1858."

the *post pyramidal ganglion* (fig. 34, e). A second larger eminence of fibres and cells extends backwards on the outer side of the preceding into the restiform body, where it gives rise to the restiform nucleus or ganglion (fig. 34, d). And lastly, the transverse piece itself behind the central canal joins, higher up, the nucleus of the eighth nerve, and contributes to the auditory nucleus.

Special deposits of gray matter.—Other masses of gray substance are deposited in the medulla, both in front and behind:—those behind are near the floor of the fourth ventricle, and serve as nuclei of origin for certain nerves; whilst those in front are amongst the fibres continued from the anterior and lateral columns of the cord.

A *nucleus of cells* for the *hypoglossal nerve* is deposited in front of the central canal, at a level marked by the point of disappearance of the anterior cornu. It is separated from its fellow by the raphé; and enlarging upwards it extends first on the side of the canal, and then into the floor of the fourth ventricle close to the median sulcus (fig. 34, o).

Another *nucleus* of cells for the accessory part of the *spinal accessory nerve* is placed opposite that of the hypoglossal nerve, but behind the central canal. Upwards it joins its fellow over the canal; and finally encroaches on the base and inner part of the posterior pyramid, from which it is partly developed.

The *nucleus of the vagus* begins on a level with the fourth ventricle (fig. 34, p), and is continuous below with that of the accessory nerve. On the surface it forms a pyriform swelling along the inner side of the pyramid, and limits with its fellow the point of the calamus scriptorius. The nuclei of opposite sides are united below over the central canal by the upper border of the gray transverse commissure. Each sinks under the auditory nucleus above, and joins a *nucleus* for the *glosso-pharyngeal nerve* in a line with it.

Above the last two nerves is another collection of cells serving as a *nucleus* for the *auditory nerve*. This projects on the lateral part of the floor of the medulla (fig. 34, r). Lying over the vagal nucleus, with which it appears to be continuous, it joins below the post pyramidal ganglion.

Gray matter at the front of the medulla.—Within the pyramid a vesicular system is developed, which increases upwards, and “forms the chief part of the gray substance of the pons Varolii.” At the front and back, as well as at the inner side of the anterior pyramid, masses of gray substance are developed, which send out fibres through the

which forms the post pyramidal, and restiform ganglion.

Special deposits of gray matter.

Nucleus of ninth nerve.

Nucleus of spinal accessory.

Nucleus of vagus.

and of glosso-pharyngeal.

Nucleus of auditory.

Anterior gray deposits

in the pyramids.

pyramid, and join the commissural fibres both at the surface and within the medulla ; whilst others disappear, " probably to become longitudinal."

Outside the pyramids is the *gray layer* of the *olivary body* (fig. 34, *f*) already described (p. 209). Behind it is another separate, elongated and flattened yellowish streak, the *accessory olivary nucleus* (fig. 34, *k*), while at the inner part of the olive near the *raphé* is a *second collection* (fig. 34, *l*), which is broken up into parts. Both of the last deposits Mr. Clarke considers to be but parts of the folds or convolutions of the olivary body.

PONS VAROLII.

Pons : The PONS, or ANNULAR PROTUBERANCE (pons Varolii, nodus encephali) (fig. 31), is situate above the medulla oblongata, and between the hemispheres of the cerebellum. In its position, in the skull it fills the hollow in front of the tentorium cerebelli. It is nearly of a square shape, though it is rather widest from side to side, and measures two inches in form, in the last direction. The anterior surface is grooved along the middle line (fig. 31), and is received into the basilar hollow in the base of the skull. By the opposite surface the pons enters into the fourth ventricle, forming part of the surfaces, floor of that space. The upper border is longest and most curved, and arches over the cerebral peduncles ; and the lower border overlays the prolongations of the medulla oblongata. On each side is the crus cerebelli, whose fibres and borders, radiate over the surface.

It is formed by longitudinal and transverse fibres. *Structure.*—In the pons are alternating strata of transverse and longitudinal fibres :—the transverse set are continuous with the fibres of the crus cerebelli, with much gray matter interspersed : the longitudinal are prolonged from the constituent bodies of the medulla oblongata.

Dissection to expose the fibres. *Dissection.*—The transverse fibres of the pons may be divided along the line of the pyramidal body of the left side, and turned outwards, so as to denude the longitudinal fibres of the pyramid. In like manner a second mass of transverse fibres, which lie below the longitudinal of the pyramid (first set) may be cut through outside the pyramidal ; and the deep longitudinal fibres of the lateral and posterior columns of the cord (second set) will appear. Amongst this last set of longitudinal fibres is the fillet of the corpus olivare, which the dissector should attempt to trace upwards from that body. The superficial fibres of the pons can be seen on the side that is untouched.

The *transverse fibres* of the annular protuberance (fig. 33), are collected chiefly into two strata—a superficial and deep, which are united in the middle line : they serve as commissural fibres of the cerebellum, and are derived from the crus or middle peduncle of that body. There are a few other transverse, that will be described with the septum.

The superficial set (fig. 31, *p*,) are mostly horizontal, but some from the lower part of the crus (*i*), ascend obliquely over the others to reach the upper margin of the pons.

The deep layer (fig. 33 *m'*,) is thickest, and contains much gray matter between its fibres.

The *longitudinal fibres* consist of three sets, viz. one from the anterior pyramidal body ; another from the lateral and posterior columns of the cord ; and a third from the corpus olivare. The fibres are not continued simply through the pons, but are increased in number by the addition of others (peduncular), which begin in the upper two thirds of the pons and join them on the outer side. It is said by some, that transverse fibres of the pons become longitudinal, and thus increase the number.

a. The fibres of the anterior pyramid (fig. 33,) pass through the pons between the two sets of transverse fibres, but not as one mass, for they are divided into a number of small bundles in their progress. Much increased in number, the fibres enter the crus cerebri at the upper border of the pons, and give rise to that fasciculated surface of the peduncle, which is now uppermost.

b. The ascending fibres of the lateral and posterior columns of the cord (fig. 33, *t*,) are altogether deeper than the commissural fibres of the pons, and are mixed up with gray matter ; they are also more numerous than the preceding set. These fibres project close to the middle line, in the floor of the fourth ventricle, and form the eminence of the fasciculus teres ; from that spot they are continued upwards to the crus cerebri, where they enter its deeper or cerebral part. In the pons a band from the olivary fasciculus is added to these fibres.

c. The olivary fasciculus (fillet, p. 209, fig. 33, *c*,) divides into two slips in the pons. One (*i*) passes backwards to the upper (in this position deeper) part of the crus cerebri, and ends in and beneath the corpora quadrigemina (p. 237). The other (*h*) is continued to the cerebrum with the fibres of the lateral column.

Septum of the pons.—In the pons, as in the medulla oblongata, there is a septum or commissure between the

The transverse fibres form a

superficial layer.

and a deep layer.

Three sets of longitudinal fibres.

From anterior pyramid,

from lateral and posterior part of spinal cord,

from olivary body.

Septum of pons.

halves, but only at the posterior part, for anteriorly the transverse or commissural fibres of opposite sides are continuous. It consists, like that of the medulla oblongata, of antero-posterior and transverse fibres.

Antero-posterior fibres.

The *antero-posterior fibres* are derived partly from the floor of the fourth ventricle ; and partly from the transverse of the pons, which bend backwards for a certain distance before they cross to the opposite side.

Transverse.

The *transverse fibres* of the pons, opposite the septum, are very slender, and are seen only on transverse sections of a hardened pons ; they come from the floor of the fourth ventricle, pierce the longitudinal fibres, and are then continued across the middle line, as in the medulla oblongata.

SECTION IV.

DISSECTION OF THE CEREBRUM.

Situation of the cerebrum.

The cerebrum, or the great brain, is the largest of the parts into which the encephalon is subdivided. It may be said to fill that part of the cavity of the skull which is above a circular line on a level with the eyebrows and the occipital protuberance.

Form ;

Taking the general form of the cranium, the cerebrum is convex on the upper aspect, and uneven on the lower aspect.

has two hemispheres

It consists of two hemispheres, which are placed side by side, and are partly separated by a median or longitudinal fissure.

joined by median parts.

Across the middle line the halves are united by certain interior parts (commissures), as well as by several connecting structures at the under surface. Superiorly the surface of the hemisphere is entire, but inferiorly it is divided into lobes.

Under surface of cerebrum.

UNDER SURFACE OF BASE OF THE CEREBRUM (fig. 35).—At its under part the cerebrum is very irregular, in consequence of its fitting into the inequalities of the base of the skull ; and on this aspect the separation into hemispheres is not complete, as on the upper surface, for the median fissure exists only at the fore and hinder parts. The following objects are to be recognised at the base of the brain :—

Division of the hemisphere.

On the under surface of each hemisphere, about one third from its front, is the fissure of Sylvius (*s s'*), which divides it into two. Of these the fore part constitutes the anterior

lobe ; and the hinder large part consists of middle and posterior lobes, but there is not any groove to mark the separation of each side. Lobes on each side.

Fig. 35.*



tion between them, the anterior border of the cerebellum being taken as the limit between the one and the other.

In the middle line, in front of the pons, are the two large white masses of the peduncles of the cerebrum (crura cerebri, *t*), one belonging to each hemisphere ; and between them is a space perforated by vessels, which is named locus perforatus posticus (*e*). Outside the peduncle is the optic tract (*u*), and between it and the inner part of the hemisphere is a fissure leading into the lateral ventricle. And parts along the middle line.

* Under surface of the brain (Quain's Anatomy). *A*, anterior ; *B*, middle ; and *C*, posterior lobe of the cerebrum. *m*. Cerebellum. *o*. Pons Varolii. *v*. Medulla oblongata. *e*. Commissure of the optic nerves. *d*. and *t*. Crura cerebri. *e*. Locus perforatus. *ff*. Convolution of the fissure of Sylvius. *h*. and *h'*. Beginning and ending of gyrus fornicatus. *i*. Infundibulum. *n*. Corpus albicans. *p*. Anterior perforated space. *r*. Tuber cinereum. *ss*. Sylvian fissure. *u*. Optic tract. *x*. Fore part of the marginal convolution. Figures 1 to 9 mark the cranial nerves.

Proceeding forwards in the middle line, the student will find two white bodies like peas, the corpora albicantia (*n*); and in front of these a grayish mass, called tuber cinereum (*r*). From the tuber cinereum a conical reddish tube, the infundibulum (*i*), descends to the pituitary body in the sella Turcica of the sphenoid bone. Anterior to this same mass (tuber cinereum), are the converging optic tracts with their commissure (*c*). Beneath the commissure of the optic nerves lies a thin grayish layer (lamina cinerea); and still farther forwards is the anterior part of the great longitudinal fissure between the hemispheres (*a*), with the white corpus callosum in the bottom of it. At the inner end of the fissure of Sylvius is another spot, perforated by vessels, and distinguished by the name substantia perforata, or locus perforatus anticus (*p*).

Parts of convolutions of corpus callosum,

Parts of some special convolutions may now be seen. One convolution, that of the corpus callosum (gyrus fornicatus) (*h*), is visible at its beginning and ending; its anterior part is in contact with the body from which it takes its name, and its posterior extremity rests on the outer side of the crus cerebri.

of median fissure,

Another is the convolution of the margin of the great median fissure, which is bare at its anterior part, and contains the olfactory nerve in a groove on its surface (*e*).

of fissure of Sylvius.

A third large convolution surrounds the fissure of Sylvius (*f*); and in that fissure are some other small convolutions, which will be examined with it.

The several parts of the base of the brain are now to be noticed more in detail.

Three lobes in each hemisphere; anterior,

Lobes of the cerebrum.—There are three lobes in each hemisphere, but this division into parts is confined to the under surface. The *anterior* lobe (*A*) is triangular in form and the apex is turned backwards; it is somewhat excavated on the surface now seen, which in the natural position of the brain rests on the orbital plate of the frontal bone. The olfactory nerve lies near the inner margin. The *middle* lobe (*B*) is the most prominent of the three, and projected, before the brain was removed, into the middle fossa of the base of the skull. The fissure of Sylvius intervenes between it and the anterior lobe. The *posterior* lobe (*C*) has no fissure to separate it from the middle one; its extent forwards is determined, as before said, by the anterior or outer margin of the cerebellum. This lobe would not be in contact with the base of the skull, supposing it in position, but would be supported on the tentorium cerebelli.

middle,

posterior.



The *fissure of Sylvius* (*s, s'*) is directed outwards between the anterior and middle lobes, and branches externally into two parts, one of which passes before, and the other behind some small convolutions, to which the term *island of Reil* has been applied. At the inner extremity of the fissure is a narrowed part, where there is a subjacent band of white fibres (*fasciculus uncinatus*) that connects the two lobes.

Fissure of Sylvius

Surrounding the cleft is the *convolution of the Sylvian fissure* (*f, f'*), which is much bent as it makes the circuit; it is joined internally by the convolutions in the fissure, and externally by convolutions on the outer surface of the hemisphere of the cerebrum.

is surrounded by a convolution,

The *island of Reil* consists of five or six small, short convolutions, which lie in the Sylvian fissure, and are concealed by the anterior and middle lobes in the natural condition of the parts. These convolutions blend with the large convolution around the fissure.

and contains other convolutions.

Peduncle of the cerebrum (*crus cerebri, d*).—This is a large, white, stalk-like body, which reaches from the upper border of the pons to the under part of the cerebral hemisphere of the same side near the inner margin. Each is about three quarters of an inch long, and widens as it approaches the cerebrum. Crossing its outer surface is the optic tract; and between the crura of opposite sides is the interpeduncular space, which contains the *locus perforatus*, the *corpora albicantia*, and the *tuber cinereum*.

Crus cerebri is fixed in the under part of hemisphere.

Structure.—The peduncle may be said to be formed by a continuation upwards of the longitudinal fibres of the pons (fig. 33), which enclose here a mass of gray matter between them.

Formed of longitudinal fibres.

Dissection.—For the purpose of showing the structure of the crus, say on the left side, the fibres continuous with the anterior pyramid should be cut across in the pons, and should be raised and carried forwards into the crus as far as the optic tract. In this proceeding the mass of gray matter (*locus niger*) will appear, and beneath it will be seen a second or deeper set of longitudinal fibres.

Dissection.

The *superficial fibres*, which form the under or free part of the crus, are continued from the anterior pyramidal body. They are longitudinal in direction, and coarse in texture, and are directed upwards radiating to the cerebrum. The surface of the peduncle, which is composed of these fibres, is called the *fasciculated* portion, or the *crust*.

Its superficial fibres

The *deeper fibres* are also prolonged to the cerebrum. They are derived chiefly from the lateral and posterior

form crust;

deep fibres

- tracts or columns of the medulla oblongata, and from the olivary fasciculus (p. 209). Some of the fibres of the lateral tract of one side cross offsets from the corresponding tract of the other, so that there is a decussation, like that in the pyramids, across the middle line; and the peduncle consequently contains fibres that are continued from both sides of the medulla oblongata.* In addition to the longitudinal fibres derived from the medulla oblongata, are others coming from the cerebellum, which mix with the former: some of these decussate also across the middle line (see p. 246). The fibres obtained from these sources are situate beneath (as now seen) the gray matter: besides being deeper, they are finer than the superficial set, and are interspersed with gray substance. The deeper part of the crus, viz., that at the cerebral aspect, is constructed by these fibres, and is named *tegmentum*.
- The gray matter (*locus niger*) of the crus, is nearer the inner than the outer margin of this body, and is convex towards the free surface, but concave in the opposite direction.
- The *posterior perforated spot* (*pons Tarini*, *e*) is situate between the peduncles of the cerebrum; grayish matter forms the floor of the space, and into it numerous vessels enter. This structure is opposite part of the floor of the third ventricle.
- The *corpora albicantia* (*corp. mamillaria*) are two small, white bodies, about the size of peas, which are formed in greater part, as it will afterwards appear, by the crus of the fornix. If one, say the left, is cut across, it will be found to contain gray matter. In front of them is a mass of gray substance.
- The *tuber cinereum* (*r*), or the mass of gray matter behind the optic commissure, forms part of the floor of the third ventricle, and is continuous with the gray substance in that cavity. In front of it is the optic nerve, and from its centre projects the following:—The *infundibulum* (funnel) is a conically-shaped tube (fig. 37, *i*), which reaches to the upper part of the posterior lobe of the pituitary body. In the fetus this tube is open between the third ventricle and the pituitary body, but in the adult it is closed inferiorly. It consists of a layer of gray matter, surrounded by the

* This is part of the median commissure of M. Foville, in the medulla oblongata, pons, and cerebral peduncles. See the work of M. Foville entitled: *Traité complet de l'Anatomie, &c., du Système Nerveux cérébro-spinal*, p. 323, 1844.

pia mater; and it is lined by the membrane of the third ventricle as far as it is pervious.

The *pituitary body* will be very imperfectly seen when it has been dislodged from its resting-place: therefore it should be sometimes examined in the base of the skull by removing the surrounding bone. Its use is unknown.

This body (fig. 37, *p*) is situate in the hollow in the centre of the sphenoid bone (the sella Turcica), and consists of two lobes, anterior and posterior. The anterior is the largest, and is hollowed out behind, where it receives the posterior lobe. In the adult this body is solid and firm in texture, and reddish in colour; but in the fetus it is hollow, and opens into the third ventricle through the infundibulum.

Structure.—It is firm and reddish externally, but softer and yellowish internally. In the *anterior lobe* are vesicular nucleated corpuscles, mixed with a granular semi-fluid substance, and the whole is contained in roundish spaces, which are constructed by a stroma of areolar tissue with blood-vessels. In the *posterior lobe* there are vessels and fine nerve tubes with a granular material and nuclei.

Dissection.—To see the lamina cinerea and the anterior termination of the corpus callosum, the convolutions of the anterior lobe of the cerebrum may be removed on the left side, where they lie over those parts. The convolution (gyrus fornicatus) in contact with the corpus callosum may be divided, and its ends turned forwards and backwards.

The *lamina cinerea* is a thin layer of gray substance, which extends backwards from the anterior termination of the corpus callosum to the tuber cinereum. This stratum closes the anterior part of the third ventricle, and is continuous laterally with the anterior perforated spot. In consequence of its great thinness, this structure is often broken through in removing the membranes of the brain.

The *corpus callosum* is now seen to be bent in front, and then to be extended horizontally backwards in the longitudinal fissure to a spot within a quarter of an inch of the anterior commissure (fig. 37, *a*), where it presents a well-marked concave margin, to which the lamina cinerea is joined. A white band, fillet or peduncle of the corpus callosum, is continued onwards, on each side, from the line of termination before alluded to, to the anterior perforated spot. To the anterior bend of the corpus callosum the term knee (genu) is applied, and to the prolonged central part the appellation beak (rostrum) has been given. Laterally the

Pituitary body.

Situation.

Structure.

Dissection.

Gray lamina.

Corpus callosum

ends inferiorly in two bands.

and extends laterally into hemisphere.

Its convolution.

Substantia perforata antica.

Position of brain to examine upper part.

Cerebrum is convex above, and divided into two.

Each half,

is marked by convolutions and sulci.

Chief convolutions.

corpus callosum reaches into the anterior lobe, and bounds the lateral ventricle in the same direction, so that an incision through it would open that cavity. In contact with this now denuded surface of the corpus callosum is the convolution named gyrus fornicatus (*h*, *h'*) which may be seen to begin by a narrow part in front of the anterior perforated spot.

Anterior perforated spot (substantia perforata antica) is a space (*p*) near the inner end of the fissure of Sylvius, which is situate between the anterior and middle lobes of the cerebrum, and in front of the optic tract. On the inner side it is continuous with the lamina cinerea; and crossing it, from within outwards, is the fillet of the corpus callosum. This space is gray on the surface; it corresponds with the corpus striatum in the interior of the brain, and is perforated by numerous vessels for that body.

Position of the part.—Now the base of the cerebrum has been dissected, the brain should be turned over for the examination of the upper part. After the brain has been turned something should be placed beneath the anterior lobes, in order that they may be raised to the same level as the posterior; and a rolled-up cloth should encircle the whole, to support the hemispheres.

UPPER SURFACE OF THE CEREBRUM.—On the upper surface the cerebrum, taken as a whole, is oval in form, with the larger end backwards; and is convex in its outline, in accordance with the shape of the skull. The cerebral mass is only partly separated into two portions or hemispheres by a median longitudinal fissure; for the corpus callosum extends from one hemisphere to another, and interrupts the depth of the fissure at the middle part, but before and behind that connecting piece its separation into two halves is complete.

Each hemisphere is smaller in front than behind. Its outer surface is convex; but the inner is flat, and in contact with the opposite hemisphere at the fore part. On the upper aspect the surface of the hemisphere is not cleft by fissures into lobes, but on the under aspect it is separated into two pieces by the large sulcus before seen. The superficies of the hemisphere is marked by tortuous eminences, like a convoluted intestine; the projections on it are named convolutions or gyri, and the intervening depressions, sulci or anfractuositities.

Convolutions.—Of the numerous convolutions the student

may notice the following as the most regular :—one on the corpus callosum ; another at the margin of the longitudinal fissure ; and some few on the outer surface of the hemisphere. The convolution of the Sylvian fissure has been already noticed (p. 219).

Dissection.—The upper part of each hemisphere having been cut off already as low as the convolution of the corpus callosum, that convolution is to be cut through on the left side, and its ends thrown forwards and backwards ; a white longitudinal band (covered band of Reil) will be seen beneath it. It is supposed that the top of one hemisphere has been kept for the purpose of examining the convolutions.

a. The convolution of the corpus callosum (gyrus fornicatus) extends around the root of the hemisphere, except at the fissure of Sylvius. It is narrow in front, and begins at the anterior perforated spot (fig. 37, *h'*) ; then courses round the corpus callosum and the crus cerebri, and ends at the posterior part of the same spot (fig. 35, *h'*). Whilst lying on the inner surface of the hemisphere, it is joined by the convolutions of that part. Beneath this convolution is a band of fibres—the covered band of Reil, fillet of the corpus callosum, which is connected in front and behind with the anterior perforated spot, and gives offsets to the secondary convolutions in the median longitudinal fissure.

b. The convolution of the margin of the longitudinal fissure (fig. 37, *x*, *x'*) takes a similar course with the preceding around the hemisphere, but it lies at the margin of the great median fissure, instead of being placed deeply in it. Commencing at the anterior perforated spot, where it forms the inner part of the anterior lobe (p. 218), it is directed back along the margin of the great fissure, and along the under part of the hemisphere to the front of the middle lobe. This is not so distinct as the preceding convolution.

c. The convolutions of the outer surface of the hemisphere cross, more or less obliquely, from the convolution of the margin of the great median fissure to the convolution of the Sylvian fissure. The posterior are most oblique and become irregular. On opposite sides of the brain these convolutions are not symmetrical.

Structure of the convolutions (fig. 36).—From the section now made into the brain each convolution may be perceived to be continuous with the interior of the brain on the one side (base) ; and to be free on the surface of the brain on the other side, where it presents a summit and lateral parts.

is gray outside

and white within.

Its structure.

Externally it consists of gray cerebral substance as a cortical layer, which is continued from one eminence to another over the surface of the hemisphere; and internally it is composed of white brain substance—its medullary part, which is derived from the fibrous mass in the interior.

On a closer examination the cortical layer is found to be composed of three strata:—an outer white stratum, an inner reddish-yellow one, and an intervening gray lamina. The outer white stratum differs in development in different parts of the brain, and is most marked over the hinder and lower portions of the convolution of the corpus callosum, where it is pierced by minute holes. The inner stratum equals in thickness the other two, and has on its external surface also a thin white lamina, so that white and gray laminae will alternate with one another in the gray matter of the convolutions.

Sulci.

The *sulci*, or the intervals between the convolutions, vary in size in different parts of the brain; they are deepest generally on the outer aspect of the hemisphere, where they measure about an inch.

The deepest where found.

There is one of considerable depth on the inner surface of the hemisphere, on a level with the corpus callosum, which projects inwards beneath an eminence (*hippocampus minor*) in the floor of the lateral ventricle. From it another sulcus is directed vertically upwards to the convex part of the hemisphere.

Composition.

INTERIOR OF THE CEREBRUM.—When viewed from the outer surface, the cerebrum appears like a twisted tube, but when a cut has been made into it, it will be found to be solid, with a convoluted crust or exterior.

Outline of hemisphere.

Each half of the cerebrum consists of a stalk or peduncle, and of a dilated part or hemisphere. Connected with the base of the foot stalk, where it joins the hemisphere, are certain central or fundamental bodies; and in the interior are some connecting pieces joining together distant parts of the brain. In the middle is a large central space, which is subdivided into smaller hollows or ventricles by the before-mentioned connecting pieces. And the whole, except the peduncle, is surrounded by a convoluted crust.

In conducting the dissection of the cerebrum, the student will have to learn the form and situation of the several constituent parts, and afterwards to trace the connections between these by means of fibres.

Centrum

Hemisphere above the ventricles.—In the right hemisphere,



which has been cut through above the level of the convolution of the corpus callosum, the surface displays a white central mass of an oval shape, the centrum ovale minus, which sends processes into the several convolutions. In a fresh brain this surface is studded with drops of blood which escape from the divided vessels.

ovale minus of the hemisphere.

When the hemispheres have been sliced off to the level of the corpus callosum a much larger white surface comes into view, which has been named larger oval centre—centrum ovale, Vieussens. The white mass in each hemisphere may be further seen to be continuous across the middle line of the brain, where it is connected by a narrowed part,—the corpus callosum.

Centrum ovale majus is deeper.

The *corpus callosum* reaches from the one half of the cerebrum to the other, and forms the roof of a space (lateral ventricle) in each hemisphere; but between the halves of the brain, where it occupies the longitudinal fissure, this body is of less extent. Here it is about four inches in length, and somewhat arched from before backwards; it is also narrower in front than behind, and extends nearer to the anterior than the posterior part of the cerebrum.

Corpus callosum.

Situation and form.

On the upper surface the fibres are directed from the hemispheres to the middle line,—the middle ones being transverse, but those from the anterior and posterior parts oblique. Along the centre is a mark or raphé, and close to it are two or more longitudinal white lines (nerves of Lancisi). Still further out may be seen other longitudinal lines (covered band, p. 223) beneath the convolution resting on the lateral part of the corpus callosum. The longitudinal fibres in the middle line are continued downwards in front, and joining a prolongation from the covered band or fillet on the side, are continued to the anterior perforated spot.

Upper surface

has transverse and longitudinal fibres.

In front the corpus callosum is bent to the base of the brain (fig. 37, *a*), as before described (p. 221); and behind it ends in a thick roll (*b*), which is connected with the sub-jacent fornix (*f*).

Anterior part bends down.

Dissection.—In order to see the thickness of the corpus callosum, and to bring into view the parts in contact with its under surface, the cut already made through that body into the ventricle is to be extended forwards and backwards on the left side, as far as the limits of the cavity. Whilst cutting through the corpus callosum, the student may observe that a thin membraniform structure lines its under surface.

Dissection.

The *corpus callosum* is thicker at each end than at the

Is thickest at each end.

centre, in consequence of a greater number of fibres being collected from the cerebrum ; and the posterior part is the thickest of all. Connected with the under surface is the septum lucidum or partition between the ventricles (fig. 37, s.), and still posterior to that is the fornix.

Use. This body is the chief commissural part of the halves of the brain, and reaches laterally even to the convolutions, but its fibres are not distinct far in the hemisphere.

Dissection. *Dissection.*—The lateral ventricle is to be dissected in the opposite hemisphere ; and to prepare it for examination, as much of the corpus callosum and white substance of the brain, as forms the roof of the cavity, is to be removed. A part of the ventricular space dips down in the middle lobe of the cerebrum towards the base of the brain, and to open it, a cut is to be carried outwards through the substance of the left hemisphere, and then downwards, also through the hemisphere, along the course of the hollow. (See fig. 36).

Five ventricles are in the brain. *VENTRICLES OF THE BRAIN.*—The ventricular spaces in the interior of the cerebrum are derived, as before explained, from the subdivision of a large central space, and are four in number. One extends into both halves of the brain ; but the part in each hemisphere is described commonly as a separate ventricle (the lateral), so that these constitute the first and second. Another (third) occupies the middle line of the brain near the under surface ; and another small one (fifth) is included in the partition between the large ventricles of the hemispheres. The fourth ventricle is situate between the cerebellum and the posterior surface of the medulla oblongata and pons.

Lateral ventricle. The *lateral ventricles* (fig. 36) are two in number, one occupying each hemisphere ; they are separated incompletely in the middle line by a septum, for they communicate by an aperture below that partition. The interior is lined by a thin stratum of nucleated epithelium, with cilia in some spots ; and at places there is a subjacent stratum of connective tissue.

Shape and position ; Each is a narrow interval, which extends into the anterior, posterior, and middle lobes of the corresponding hemisphere. Its central part (body) is almost straight, but the points (cornua) by which it reaches into the different lobes are curved. Thus there are three cornua in each, which have the following disposition :—The anterior (fig. 36, g) is directed outwards from its fellow in the other hemisphere. The posterior or the digital cavity (h) is much smaller in

three
cornua.

size, and is bent inwards in the posterior lobe towards the one of the opposite side. And the inferior cornu, beginning opposite the posterior fold of the corpus callosum,

Fig. 36.*



descends in a curved direction in the middle lobe (*g*), with the concavity of the bend turned inwards.

For the purpose of examining its boundaries, the ventricle may be divided into an upper or horizontal, and a lower or descending part. Consists of two parts.

The upper or horizontal part (fig 36, *g* to *h*) reaches from the anterior into the posterior lobe, and is shaped like the One is horizontal. Italic letter *f* inverted. Its *roof* is formed by the corpus Its roof; callosum. Its *floor* is irregular in outline, and presents floor, from before backwards the following parts:—first, a small

* View of the lateral ventricles (Quain's Anatomy). *c.* Fore part of corpus callosum: the hollow behind it is the fifth ventricle. *c.* Choroid plexus. *f.* Body of the fornix. *g.* Anterior cornu. *h.* Posterior cornu. *k.* Corpus striatum. *l.* Optic thalamus. *n.* Hippocampus minor. *o.* Posterior pillar of the fornix continued into the corpus fimbriatum. *p.* Hippocampus major. *r.* Convolutions of the exterior. *s.* Tænia semicircularis. *y.* Eminentia collateralis.

and bodies
along it.

piece of the under part of the corpus callosum (*c*) ; next, a large, gray, pear-shaped body, the corpus striatum (*k*) ; behind this, another large white projection, named optic thalamus (*l*) ; and between the two last bodies is a white line (*s*), tænia semicircularis. On the surface of the optic thalamus is a vascular fold of the pia mater (*e*), known as the plexus choroides, together with the thin white edge of the fornix (*f*). Close behind the optic thalamus is the beginning of a projection (hippocampus major), that lies in the floor of the descending part of the lateral ventricle (*g*) ; and in the posterior cornu is an elongated eminence, the hippocampus minor (*n*). The *inner boundary* of the ventricle, or the septum ventriculorum, is a thin partition, which has been named septum lucidum ; below the anterior part of this partition, opposite the front of the optic thalamus, is the aperture of communication (foramen of Monro) between the two lateral ventricles.

Inner
boundary.

Aperture,
between.

The de-
scending
part ;
roof ;

floor,

and bodies
on it.

The lower or descending part of the ventricle winds beneath the optic thalamus, and forms a curve like the half-bent fore finger. Forming the *roof*, will be the optic thalamus and the contiguous part of the hemisphere. In the *floor* is a large curved, convex eminence, somewhat indented at the end, which is called the hippocampus major (*g*) ; and along its concave margin is a thin white band—tænia (*v*), that is prolonged from the fornix. External to the projection of the hippocampus is another white eminence, the pes accessorius (*y*), or eminentia collateralis. In this part of the ventricle is the vascular fringe of the plexus choroides : it enters by a fissure internal to the hippocampus.

Septum
lucidum ;

position,
form,

surfaces,

borders,

structure.

Dissection.

The *septum lucidum* (fig. 37, *s*), or the thin partition between the lateral ventricles, is a translucent part of the cerebral mass, which hangs vertically in the middle line between the corpus callosum and the fornix. It is somewhat triangular in form, with the larger part turned forwards, and the narrow or pointed extremity directed backwards. Its surfaces look to the lateral ventricles. The upper border is attached altogether to the under aspect of the corpus callosum ; and the lower border is joined in part to the fornix (*f*), but in front of that body it is connected with the under or prolonged portion (rostrum) of the corpus callosum. The septum consists of two layers, which enclose a space—the fifth ventricle ; and each layer is formed of white substance, with an external coating of gray matter.

Dissection.—The space of the fifth ventricle will come into view by cutting through the part of the corpus callosum

that remains in the middle line, and by detaching the anterior half from the septum lucidum, so that it can be raised forwards. (See fig. 36).

Fig. 37.*



The *ventricle of the septum*, or the fifth ventricle (fig. 36, c), exists in the anterior part of the ventricular partition, where the depth is greatest. Like the septum that contains it, its largest part is in front. In the adult it is a closed space, but in the fetus it opens inferiorly into the third ventricle between the pillars of the fornix. Its surface has an epithelial covering like that in the lateral ventricles.

Dissection.—The fornix should be next examined. To lay bare this body the posterior part of the corpus callosum should be detached with care from it, and thrown backwards; and the septum lucidum should also be removed from its upper surface.

* Vertical section through the middle of the encephalon (Sömmerring). *a* and *b*. Front and back of corpus callosum. *c*. Soft commissure. *d* and *e*. Inner part of optic thalamus, bounding the third ventricle. *f*. Fornix, and *g*, its anterior crus. *h* and *h'*. Gyrus fornicatus; and touching the convolution behind at *h*, is the thin lamina cinerea. *i*. Infundibulum. *k*. Corpora quadrigemina, over the passage called aqueduct of Sylvius. *n*. Corpus albicans. *p*. Pituitary body. *r*. Choroid plexus. *s*. Septum lucidum. *t*. Crus cerebri, cut. *u*. Pineal body. *v*. Valve of Vieussens. *x* & *x'*. Marginal convolution of the longitudinal fissure. The figures refer to some cranial nerves.

Fornix : position and form. The *fornix*, or arch (fig. 36, *f*), is a thin white horizontal stratum beneath the corpus callosum, which, projecting on each side into the lateral ventricle, forms part of the floor of that cavity. It is triangular in shape, with the base turned backwards ; and it is continuous with the rest of the brain only by its apex and base, where it gives off processes or crura both before and behind.

Posterior and anterior part. At its posterior part or base, the fornix has the following arrangement :—In the middle line it joins the corpus callosum, whilst on each side it sends off a small riband-like band—*tenia hippocampi* (fig. 36, *e*), along the concave margin of the hippocampus major. At the anterior part, or apex, it is arched over the foramen of Monro, opposite the front of the optic thalamus, and ends likewise in two processes or crura (fig. 37, *g*), which will be afterwards followed to the corpora albicantia and the optic thalami (p. 236). To the upper surface, along the middle line, the septum lucidum is attached. Each border is free in the corresponding lateral ventricle, where it rests on the optic thalamus, and along it lies the choroid plexus.

Upper surface and borders. If the fornix be cut across near its front, the foramen of Monro will be opened, and the descending anterior pillars will be seen. When the posterior part is raised, the fornix will be found to be supported on a process of the pia mater, named *velum interpositum* ; and at its base (on the under aspect) between the two offsets, or the *teniae hippocampi*, is a triangular surface, which is marked by transverse and sometimes by longitudinal lines : the surface which is so defined has been called incorrectly by some the *lyra*.*

Under surface. The fornix may be also described as consisting of two bands, right and left, which are united for a certain distance in the central part or body. According to this view, each band, commencing in the optic thalamus, passes over the foramen of Monro, and after forming the body of the fornix, is continued as a distinct piece to the surface of the hippocampus major.

marked by lines. The *Foramen of Monro* is the aperture beneath the anterior part of the fornix, in which the plexus choroides lies. Through it the lateral ventricles communicate with one another and with the third ventricle.

Fornix formed of two bands. FLOOR OF THE LATERAL VENTRICLE.—The student may

* See a foot note by Dr. Sharpey, in Quain's Anatomy, vol. ii. p. 471.

leave untouched, for the present, the membrane on which the fornix rests, and proceed to examine, on the left side, the different bodies that have been enumerated as constituting the floor of the lateral ventricle. lateral ventricle are

The *corpus striatum* (superior ganglion of the cerebrum) (fig. 36, *k*), is the large gray body in the anterior part of the lateral ventricle. It is placed opposite the island of Reil in the fissure of Sylvius; and it has received its name from the striated appearance of a vertical section. striate body in front.

Dissection.—To see the structure of the corpus striatum, the student should make a cut in it from before backwards, until certain white fibres crossing it obliquely from within outwards are reached. The knife should then be carried through this layer of white fibres until another mass of gray substance, similar to the first, is arrived at. Dissection for structure.

The *striate body* appears to be a pyriform mass of gray matter of considerable thickness, which is surrounded by the white substance of the hemisphere, except where it projects into the lateral ventricle. Its position is oblique with respect to the middle line of the brain, for the anterior part is near the septum of the ventricles, whilst the posterior part is external to the optic thalamus. By means of the incision that has been made into the corpus striatum, white fibres can be seen to be directed through it in such a way as to divide the mass of gray matter into two parts,—one being situate in the ventricle (intraventricular) above the white fibres, and the other outside the ventricular space, below those fibres (extraventricular). its form, position; is divided into two parts by white fibres.

a. The *intraventricular* part (*nucleus caudatus*) of the striate body is pear-shaped, and projects into the floor of the ventricle. The end, directed forwards, is large and rounded; whilst the opposite end is thin and pointed, and is continued backwards, outside the optic thalamus, to the roof of the descending cornu of the lateral ventricle. Numerous veins cover this part of the corpus striatum. One part in the ventricle.

b. The *extraventricular* part (*nucleus lenticularis*) will be best seen, afterwards, by sections made from the outer side or from below. It is oval in form, but does not reach so far back as the other, and is bounded inferiorly by a white capsule; through it the anterior commissure of the brain passes very obliquely, as a subsequent dissection will show. the other outside that cavity.

The *laminæ semicircularis* (fig. 36, *s*) is a thin white band of longitudinal fibres, which lies between the corpus striatum and the optic thalamus. In front this band becomes broad, and joins the pillar of the fornix; and behind it is continued, Tenuis semi-circularis

with those
of Galen.

Along the centre of the velum are two large veins, *veins of Galen*, which begin at the foramen of Monro, by the union of branches from the corpus striatum and the choroid plexus. Lying side by side in the membrane, these veins are usually united into one at the posterior part of the velum, which opens into the straight sinus.

Dissection.

Dissection.—When the velum interpositum has been raised and thrown backwards, the third ventricle will be visible. In reflecting the piece of pia mater the student must be careful of the pineal body, which would otherwise be detached. On the under surface of the velum are the choroid plexuses of the third ventricle.

Other cho-
roid plex-
uses.

The *choroid plexuses* of the *third ventricle* are two fringed bodies beneath the velum, which resemble the like parts in the lateral ventricle.

Third ven-
tricle

The *third ventricle* is an interval between the optic thalami (fig. 37, *e* to *d*), and reaches to the base of the brain.

is near base
of brain.

Its situation is in the middle line of the cerebrum, and below the level of the other ventricles, with which it communicates. Its boundaries and communications are the following :—

Roof.

The roof is formed by the velum interpositum and the fornix. The floor is very oblique from behind forwards, so

Floor.

that the depth of the cavity is greatest in front: corresponding with the floor are the parts at the base of the brain, which lie between the crura cerebri and the anterior longitudinal fissure, viz. locus perforatus, corpora albicantia, tuber cinereum, commissure of the optic nerves, and lamina cinerea. On the sides of the cavity the optic thalami are situate. In front of the space are the descending pillars of the fornix, with part of the anterior commissure of the cerebrum in the interval between them. Behind are the posterior commissure and the pineal body. Crossing the centre of the space, from one optic thalamus to another, is a band of gray matter—the soft commissure, (*c*).

Parts on the
sides,

in front,
and behind.

Opening
into other
ventricles.

This space communicates with the other ventricles of the brain in the following way :—In front it joins each lateral ventricle through the foramen of Monro, and opens into the fifth ventricle in the fetus. Behind is an opening into the fourth ventricle, beneath the posterior commissure, which is named aqueduct of Sylvius. At the lower part, in front, there is a depression opposite the infundibulum (*iter ad infundibulum*). The lining of the ventricle is continued into the neighbouring cavities through the different apertures of communication, and closes the *iter ad infundibulum*.

Gray matter of the ventricle.—A stratum of gray matter covers most of the surface of the ventricle. At the lower part of each optic thalamus it envelops the crus of the fornix, and ascends to the septum lucidum; and in the floor of the cavity it exists in abundance, entering into the corpora albicantia, and uniting the structures that form the floor of the third ventricle. In the middle of the space it reaches from side to side, and forms the soft commissure.

The *anterior commissure* of the cerebrum is a round bundle of white fibres, which passes through both corpora striata, and connects the opposite hemispheres. To see it in one half of its extent, the student should make the following dissection :—

Dissection.—On the side on which the corpus striatum has been cut into, the commissure is to be followed into the interior of that body, by scraping away the gray matter (intraventricular) with the handle of the scalpel. The commissure may be seen then to perforate below the white fibres of the corpus striatum, and to pass through the other mass of gray matter (extraventricular) of the same body.

The *anterior commissure* is free only in the middle line, where it lies before the pillars of the fornix; for it perforates the corpus striatum, passing in succession through the intraventricular gray mass, the white fibres, and the extraventricular gray mass. Lastly, the commissure pierces the white stratum bounding externally the corpus striatum, and ends in the roof of the inferior cornu of the lateral ventricle.

The *posterior commissure* of the cerebrum is smaller than the anterior, and is placed above the passage into the fourth ventricle. Laterally it enters the substance of the optic thalamus, and piercing it, ends in the hemisphere.

The *thalamus opticus* (inferior ganglion of the cerebrum) will be best seen on the side on which the inferior cornu of the lateral ventricle has been opened. It is a square-shaped body, which forms part of the lateral and third ventricles.

The upper surface projects in the floor of the lateral ventricle (fig. 36, D), and is marked in front by a prominence—*anterior tubercle*, near the *tænia semicircularis*. The under surface forms part of the roof of the inferior cornu of the lateral ventricle, and into it the *crus cerebri* is inserted. By its inner side this body enters into the third ventricle; and along the upper part lies the peduncle of the pineal body. On the outer side are the corpus striatum, and the substance of the hemisphere. The anterior part looks to the foramen of *Monro*. And the posterior part, which is

Gray matter of the ventricle.

Anterior commissure: form and extent.

To see it, cut corpus striatum.

Position; and course to roof of inferior cornu.

Posterior commissure.

Thalamus opticus. Form and Position.

Upper surface.

Under part. Inner side.

Outer side, anterior, and posterior parts.

free in the inferior cornu of the lateral ventricle, presents inferiorly two small roundish tubercles, which are placed one outside and the other inside the bend (*genu*) of the optic nerve, and are named from their position to it, internal and external geniculate bodies.

Origin of
optic nerve.

The *origin* of the *optic nerve* from the thalamus, and from the geniculate and quadrigeminal bodies, can be now seen. At the back of the *crus cerebri* the optic tract receives fibres from the optic thalamus which it touches, and then divides into two terminal bands:—one of these is connected with the gray matter in the external geniculate body, and is continued onwards to one of the *corpora quadrigemina* (*nates*); the other is similarly connected with the internal geniculate body, and is then prolonged to the other quadrigeminal body (*testis*) of the same side.

Dissection.

Dissection.—The origin of the *fornix* in the optic thalamus may be followed out next. As a preparatory step the anterior commissure and the anterior part of the *corpus callosum* should be cut along the middle line, so that the left hemisphere can be separated from the other. On the left hemisphere the *crus* of the *fornix* is to be traced downwards, first to the *corpus albicans*, and then upwards into the optic thalamus.

Origin of
fornix in
optic thalamus;

Anterior pillar of the fornix (fig. 38, *t*).—The *fornix* begins in the thalamus opticus near the tubercle on the upper surface. From this origin it descends in a curved direction to the *corpus albicans*, where it makes a turn like half of the figure 8, and furnishes a white envelope to the gray matter of that body. The *crus* then ascends, being bent forwards, through the gray substance on the side of the optic thalamus; and it is joined by the fibres of the *tænia semicircularis* and peduncle of the pineal gland. Lastly, the *crus* is applied to the like part of the opposite side to form the body of the *fornix*.

how forms
corpus albicans.

Joined by
other fibres.

The *pineal body* and the *corpora quadrigemina*, which are placed behind the third ventricle, may be next examined.

Dissection.

Dissection.—All the *pia mater* should be carefully removed from the surface of the quadrigeminal bodies, especially on the left side, on which they are to be seen. The posterior lobe of the hemisphere of the same side may be cut off.

Pineal
gland;
position.

The *pineal gland* (*conarium*) is a small conical body (fig. 37, *u*), which is situate above the posterior commissure, and between the anterior pair of the *corpora quadrigemina*. In shape like the cone of a fir, it is less than a quarter of an

inch in length, and has the base or wider part turned forwards. It is connected to the optic thalami by two white bands,—peduncles of the pineal body: these begin at the base of the pineal gland, and extending forwards, one on each side, along the inner part of the optic thalami, end by joining the crura of the fornix. The base of the gland is further connected by transverse white fibres with the posterior commissure.

attachment
to thalamus.

This body is of a red colour and vascular, and encloses a cavity. It contains in its substance large pale nucleated cells without offsets, with a few nerve fibres, and some calcareous material (brain sand) consisting of particles of phosphate and carbonate of lime and magnesia.*

Structure.

The *corpora quadrigemina* (fig. 37, *k*) are four small bodies, which are arranged in pairs, right and left, and are separated by a median groove. Each pair is situate on the cerebral aspect of the peduncle of the cerebrum of the same side.

Corpora
quadrigem-
ina.
In pairs on
each side.

The anterior eminence (*nates*) is somewhat larger than the posterior, from which it is separated by a slight depression; it is oblong from before backwards, and sends forwards a white band to join the optic thalamus and the optic nerve.

Anterior
one (*nates*).

The posterior eminence (*testis*) is rounder in form and whiter in colour than the preceding: it has also a lateral white band, which is directed beneath the corpus geniculatum internum, and blends with the optic tract and the thalamus opticus.

Posterior
one (*testis*)
both join
thalamus.

These bodies are small masses of gray substance enveloped by white, and are placed on the band of the fillet that forms the roof of the aqueduct of Sylvius. The processes (*brachia*) to the optic thalamus are accessory parts to the peduncular fibres of the cerebrum.

Structure
and their
bands.

Fillet of the olivary body.—If the upper margin of the cerebellum be pulled aside, a white band, about a quarter of an inch in width, will be seen to issue from the transverse fibres of the pons, and to be directed upwards to the corpora quadrigemina (fig. 38, *i*). This is the upper or commissural piece of the fillet (p. 215), which passes to the corpora quadrigemina, and joins beneath them, over the Sylvian aqueduct, with the similar part of the opposite side.

Fillet of
olivary body

passes be-
neath cor-
pora quadri-
gemina.

STRUCTURE OF THE CEREBRUM. — In each cerebral

Three sets of

* These particles are referred to by Kölliker as pathological products, and the concentrically arranged masses amongst them are said to be incrustations of fibrin coagula.

fibres in
cerebrum.

hemisphere three principal sets of constituent fibres are recognised, viz., diverging, transverse, and longitudinal: the former are in part continuous with those of the spinal cord; while the two latter join distant parts of the cerebrum, and are considered to be only connecting or commissural in their office.

Fibres of
crus cerebri
to the hemi-
sphere.

A. *Peduncular or diverging fibres* (fig. 38).—In the crus cerebri or the root of the cerebral hemisphere, two bundles of longitudinal fibres are collected; these are separated, in part, by gray matter, and are derived from the medulla oblongata (p. 219). From this source the hemisphere may be said to spring.

Dissection of
them

Dissection.—A complete systematic view of the diverging fibres cannot be given now, because the dissection necessary for that purpose would destroy parts that have not been yet seen. At this stage the chief purpose is to show the passage of the radiating fibres from the crus through the two cerebral ganglia.

in the corpus
striatum

To trace the diverging fibres onwards, beyond the crus cerebri, and through the corpus striatum, the nucleus caudatus of that body which covers them should be scraped away; and this dissection should be made on the side on which the striate body and the optic thalamus remain uncut. In this proceeding the pecten of Reil comes into view, viz., gray matter passing between the white fibres, and giving the appearance of the teeth of a comb.

and optic
thalamus,

On taking away completely the prolonged part of the nucleus, others of the same set of fibres will be seen issuing from the outer side of the optic thalamus, and then radiating to the posterior and inferior lobes. After tracing those fibres, a part of the upper surface of the optic thalamus may be taken away at the posterior end, to denude an accessory bundle to the peduncular fibres, which comes beneath the corpora quadrigemina from the superior peduncle of the cerebellum.

Fibres of
peduncle
diverge

Their *arrangement* (fig. 38).—The *diverging fibres* radiate from the peduncle of the cerebrum to the surface of the hemisphere, passing in their course through the two cerebral ganglia (optic thalamus and corpus striatum), and they form a conically-shaped bundle, whose apex is below and base above.

in corpus
striatum
and optic
thalamus:

The fibres forming the free or fasciculated part of the peduncle pass mostly through the striate body; whilst those on the opposite aspect of the peduncle, which form its tegmentum (fig. 38, *h*), are transmitted chiefly through the

under part of the optic thalamus, though some pass through both corpus striatum and optic thalamus. In those two ganglionic bodies the fibres are greatly increased in number; and in the optic thalamus, they receive accessory bundles their accessory bands from the superior peduncle of the cerebellum (p. 245), from the fillet of the olivary body, from the pair of the corpora

Fig. 38.*



quadrigemina on the same side, and from the corpora geniculata.

On escaping from the striate body and the thalamus the fibres radiate into the anterior, middle, and posterior parts of the cerebral hemisphere, forming the *corona radiata*. In the hemisphere the fibres are continued to the convolutions, but before reaching the circumference of the brain they decussate with the converging fibres of the corpus callosum. Their expansion in the hemisphere resembles a fan bent In the hemisphere they extend to convolutions.

* Upper view of the peduncular fibres (Arnold). *a*. Fasciculus teres. *b*. Fascicular fibres continued into the crus cerebri on the upper aspect (the tegmentum). *c*. Corpora quadrigemina. *f*. Superior peduncles of the cerebellum. *i*. Upper part of the fillet. *k*. Corpus striatum. *l*. Thalamus. *s*. Under portion of corpus callosum in front, decussating laterally at *y*, with the diverging fibres. Other parts are—*p*. Posterior pyramid; *e*. restiform body; *n*. middle peduncles of the cerebellum cut across; *q*. upper surface of corpus callosum.

down in front and behind, forming thus a layer which is concave on the under side.

Fibres not reaching throughout.

Their *extent*.—All the fibres of the peduncle do not reach the surface of the brain, nor are all those at the circumference derived originally from the peduncle: for some of the fibres of the crus cerebri end in the corpus striatum and the optic thalamus, especially in the former; and others extend only from those ganglionic bodies to the surface of the hemisphere.* Thus, in addition to the fibres that extend throughout, viz. from the crus to the surface, some connect the peduncle of the cerebrum with the ganglia, and others connect the ganglia with the convolutions on the exterior.

Source from cord.

Their *source*.—The fibres thus entering inferiorly the cerebrum through its peduncle, and continued thence to the periphery of the hemisphere, are derived from all three components of the medulla oblongata (fig. 38), viz., anterior pyramid, lateral column, and restiform body; and therefore indirectly from all the divisions of the spinal cord (p. 207).

Decussation.

The *decussation* between the fibres of opposite sides have been before referred to (p. 210, 220).

Commissural transverse fibres.

B. The *transverse or commissural fibres* connect the hemispheres of the cerebrum across the middle line. They give rise to the great commissure or the corpus callosum (fig. 38, g and s) (p. 225), and to the anterior and posterior commissures (p. 235). These bodies have been already examined.

Commissural longitudinal fibres

C. *Longitudinal fibres*.—Other connecting fibres pass from before backwards, uniting together parts of the same hemisphere, and having mostly a circular arrangement.

are found in fornix and its accessory parts; and on, and under corpus callosum.

The chief fibres of this system are collected in the following bands, viz. the fornix, the tænia semicircularis, and the peduncles of the pineal body. Other longitudinal fibres may be enumerated on the upper and under surfaces of the corpus callosum, along the middle line; together with the band of the convolution of the corpus callosum: the fibres in contact with the corpus callosum are connected with the anterior perforated spot of the base of the brain.

Optic thalamus differs above and below.

Structure of the optic thalamus.—On making sections of the optic thalamus on the side on which it is entire (the left), this body will be found to consist of layers of gray and white substance, at the upper and inner parts; and of

* According to Kölliker and others, none of the fibres of the peduncle reach farther than the corpus striatum and the optic thalamus.

the medullary fibres (tegumentum) of the peduncle of the cerebrum, at the lower and outer parts.

Corpus striatum.—By slicing through the corona radiata on the right side, so as to bring into view the extraventricular part (nucleus lenticularis) of the corpus striatum, the extent and form of that mass, and the situation of the anterior commissure will be apparent.

Section of corpus striatum from outside.

Crus cerebri.—By a vertical section through the right peduncle of the cerebrum, the disposition and the thickness of the two layers of its longitudinal fibres, and the situation of the locus niger between them may be perceived.

Section of crus cerebri.

Dissection.—The cerebellum is to be detached from the remains of the cerebrum, by carrying the knife through the optic thalamus so that the cerebellum with the corpora quadrigemina, the crura cerebri, the pons, and the medulla oblongata, may remain united together.

Proceeding to prepare cerebellum

When the cerebellum, united with the other parts mentioned above, has been detached from the cerebrum, all the pia mater is to be carefully removed from the fissure on its under surface; and the different bodies in that fissure are to be separated from one another. Lastly the handle of the scalpel should be passed along a sulcus at the circumference of the cerebellum between the upper and under surfaces.

Parts to be separated from one another.

SECTION V.

THE CEREBELLUM.

The *cerebellum*, little brain (fig. 39), is flattened from above down, so as to be widest from side to side, and measures about four inches across. This part of the encephalon is situate in the posterior fossæ of the base of the skull, beneath the tentorium cerebelli. Like the cerebrum, it is incompletely divided into two hemispheres,—the division being marked by a wide groove along the under surface, and by a notch at the posterior part which receives the falx cerebelli.

Form and position of cerebellum. Divisions.

UPPER SURFACE.—On the upper aspect the cerebellum is raised in the centre, but is sloped towards the circumference. There is not any median sulcus on this surface, and the halves are united by a central constricted part or isthmus,—the superior vermiform process. Separating the upper from

No groove on the upper surface; halves joined by median part.

the under surface, at the circumference, is the horizontal fissure, which is wide in front, and extends backwards from the pons to the middle line of the cerebellum.

Laminæ and their arrangement.

The surface of the cerebellum is marked by plates or laminæ, instead of convolutions, which are notched on the sides, and form segments of circles, with their convexity directed backwards, and with a concentric arrangement. On the upper aspect the laminæ pass from the one hemisphere to the other, with only a slight bending forwards of the most anterior in the superior vermiform process; but on the under aspect they join the sides of the different bodies, or commissures in the median fissure. Between the laminæ are sulci or fissures, which are lined by the pia mater, and reach to different depths: the shallower of these separate the laminæ; but the deeper limit the lobes, and reach downwards to the white substance of the interior. Here and there the sulci are interrupted by cross laminæ.

Sulci are shallow and deep.

A fissure is present below,

The UNDER SURFACE is convex, being received into the fossæ of the base of the skull, and is divided into hemispheres (fig. 39, *w*) by a median hollow (vallecula).

Fig. 39.*



which is called valley, and contains

The *central sulcus*, or the vallecula, receives the medulla oblongata, *m*, being cut away in greater part. *c*. Pons Varolii, with the cerebellum attached to the sides. *l*. Flocculus or subpeduncular lobe. *n*. Amygdaloid lobe. *i* to *s*. Inferior vermiform process, consisting of the following parts:—*p*. Pyramid. *r*. Uvula, and *s*. Nodule. *x*. Posterior medullary velum. The cranial nerves are marked by figures.

* Under part of the cerebellum seen from before (Reil), the medulla oblongata, *m*, being cut away in greater part. *c*. Pons Varolii, with the cerebellum attached to the sides. *l*. Flocculus or subpeduncular lobe. *n*. Amygdaloid lobe. *i* to *s*. Inferior vermiform process, consisting of the following parts:—*p*. Pyramid. *r*. Uvula, and *s*. Nodule. *x*. Posterior medullary velum. The cranial nerves are marked by figures.

is a mass named inferior vermiform process (fig. 39, *i* to *s*), which corresponds with the central part connecting the halves of the cerebellum on the upper surface: the two parts constitute the general commissure of the halves of the cerebellum.

Constituents of the vermiform process.—Entering into the constitution of the inferior vermiform process are the following eminences, which may be easily separated from one another with the handle of the scalpel:—Most anteriorly is a narrow body, the *uvula* (fig. 39, *r*), which is named from its resemblance to the same part in the throat; it is longer from before backwards than from side to side, and is divided into laminae. Its anterior projection into the fourth ventricle is named *nodule*, or laminated tubercle, *s*; and on its side is a ridge of gray matter, the *furrowed band*, which is notched on the surface, and unites it with the almond-like lobe of the hemisphere. Connected with the nodule is a thin white layer,—the *medullary velum*; but this and the furrowed band will be seen in a subsequent dissection (p. 244). Behind the uvula is a tongue-shaped body, named *pyramid*, *p*, which is elongated from side to side, and is marked by transverse laminae. Still farther back are certain transverse pieces, *i*, extending between the posterior lobes of the hemispheres, of which they were considered by Reil to be the commissures.

LOBES OF THE HEMISPHERE.—Each hemisphere is subdivided into lobes on both the upper and the under aspect (fig. 39).

On the upper surface there are two lobes, anterior and posterior, which are separated by a sulcus, but the interval between them is not well marked. The *anterior* or square lobe extends back to a level with the posterior edge of the vermiform process; and the *posterior* reaches thence to the great horizontal fissure at the circumference.

On the under surface of the cerebellum, there are five lobes; and three of them are separated by sulci amongst the laminae of the hemisphere, but they are not more distinct than the lobes on the upper surface:—

Beginning behind, the student will meet first the *posterior lobe*, which joins the commissural laminae behind the pyramid in the vallecula. Next in order is the *slender lobe*, which is connected with the posterior part of the pyramid, as well as with the other transverse laminae behind that body. And lastly, attached to the side of the pyramid, is the *biventral lobe*.

- Two other lobes in valley : amygdaloid The two other lobes, though smaller, are more evident, and appear between the biventral lobe and the medulla oblongata :—One of these is the *amygdaloid lobe* (fig. 39, *n*), which projects into the vallecule opposite the uvula, and touches the medulla oblongata. The other is a small pyramidal slip, which is directed outwards over (the under surface of the cerebellum being uppermost) the crus cerebelli, and is named *flocculus*, or subpeduncular lobe (fig. 39, *l*).
- and flocculus. Dissection.—To see the flocculus and the posterior medullary velum, the biventral and slender lobes of the under surface are to be sliced off, on the left side, so that the amygdaloid lobe may be everted from the valley. The flocculus is laid bare by this proceeding, and passing from it to the tip of the uvula is the thin white layer of the posterior velum ; beneath the last a bit of paper may be inserted. The furrowed band on the side of the uvula can be fully seen now.
- Position and structure of flocculus. *Flocculus and medullary velum.*—The position of the flocculus to the crus cerebelli, and in front of the biventral lobe, has been before mentioned. This body resembles the other lobes in structure ; and it may be considered a rudimentary lobe, for it is divided on the surface into laminæ (fig. 39, *l*), and contains a white medullary centre, from which offsets are furnished to the laminæ.
- Posterior medullary velum. Passing from the flocculus to the tip of the inferior vermiform process (nodule) is the half of a thin white layer (fig. 39, *x*), the *medullary velum* (inferior or posterior), which serves as a commissure to the flocculi. On each side this band is semilunar in form. Its anterior edge is free, but its posterior border is attached in front of the transverse furrowed band. In front of the nodule the pieces of opposite sides are united, and form the membranous velum.
- Form and attachments. INTERIOR OF THE CEREBELLUM.—In the cerebellum there is not any cavity or ventricle enclosed as in the cerebrum. In the interior there is a large white centre, corresponding with that of the cerebrum, which furnishes offsets to the laminæ, and to other parts of the encephalon. The space of the fourth ventricle is between the cerebellum and the medulla oblongata.
- Cerebellum is solid internally. Dissection.—For the purpose of seeing the structure of the laminæ, an incision may be made across them on the upper surface of the left hemisphere.
- Dissection of laminæ, of centre, And the medullary centre, with its contained corpus deu-

tatum, may be seen on the right side by removing all the laminae from the upper surface. This dissection may be accomplished by placing the scalpel in the horizontal fissure at the circumference, and then carrying it inwards as far as the upper vermiform process, so as to detach the cortical stratum. If the corpus dentatum does not at first appear, thin slices may be made till it is reached.

and corpus dentatum.

Structure of the laminae.—Each lamina consists of a white internal, and a gray external substance (fig. 37). The white part is derived from the central medullary mass ; and dividing, like the branching of a tree, it ends in small lateral offsets which enter the subdivisions of the laminae.

A lamina has white inside ;

Besides the white stalk of the lamina, derived from the central mass, there are other white fibres which pass from one lamina to another.

collateral, white fibres ;

The stratum of gray matter enveloping the white substance resembles somewhat the cortical covering of the convolutions of the cerebrum. It is constructed of two strata, inner and outer, which can be distinguished by a difference in their colour. The superficial stratum is gray, and about equal to the other in thickness ; but the deeper one is of a rust-colour, and is generally thickest in the hollows between the laminae.

and gray outside.

MEDULLARY CENTRE.—In the centre of each cerebellar hemisphere is a large white mass, containing in its substance a dentate body. From its surface offsets are furnished to the different laminae. And from the anterior part proceeds a large stalk-like process : this is divided into three pieces or peduncles, which connect the cerebellum with other parts, viz., an upper offset to the cerebrum, a middle piece to the pons, and a lower one to the medulla oblongata.

White centre of cerebellum. Gives offsets, viz.,

a. The *superior peduncle* (processus ad cerebrum) is directed forwards towards one (testis) of the corpora quadrigemina (fig. 38, f). It is rather flattened in shape, and forms part of the roof of the fourth ventricle : between the processes of opposite sides the valve of Vieussens is situate. Continuous behind with the inferior vermiform process (fig. 33, r), its fibres receive an offset from the interior of the corpus dentatum, and pass beneath the band of the fillet, and beneath the pair of the corpora quadrigemina of the same side, to enter the optic thalamus.

superior peduncle

is above fourth ventricle.

Beneath the corpora quadrigemina the internal fibres of this peduncle are directed inwards, through the bundle of the fasciculus teres, and cross the corresponding fibres of the

Its fibres partly decussate.

other side, forming thus a decussation like that of the pyramids* (p. 210). In this way the fibres of each peduncle end partly in the same, and partly in the opposite hemisphere of the cerebrum.

Valve of
Vieussens
between the
two.

Between the superior peduncles is the thin, translucent, white layer,—the *valve of Vieussens* (velum medullare anterius), which forms part of the roof of the fourth ventricle (fig. 37, *v*). It is thin and pointed anteriorly, but widens behind, where it is connected with the under part of the vermiform process. Near the corpora quadrigemina the fourth nerve is attached to the upper surface of the valve,—the nerves of opposite sides being united; and near the lower part, the upper surface is marked by some gray transverse ridges.

Middle pe-
duncle

b. The *middle peduncle* (processus ad pontem) is commonly named *crus cerebelli* (fig. 39), and is the largest of the three peduncular processes. Its fibres begin in the lateral part of the cerebellum, and are directed forwards to the pons, of which they form the transverse fibres, and in which they unite with the fibres of the peduncle of the opposite side. This peduncle is supposed to perform for the cerebellum, the same office as the corpus callosum does for the cerebrum, viz., to serve as a commissural or connecting piece.

is the com-
missure of
cerebellum.

Inferior pe-
duncle.

c. The *inferior peduncle* (fig. 33, *n*) (processus ad medullam) passes downwards to the medulla oblongata, and forms part of the restiform body (*e*). Its fibres are connected chiefly with the laminae of the upper surface of the cerebellum. It will be better seen when the fourth ventricle has been opened.

Fibres of

Course of the fibres.—The fibres contained in the peduncles of the cerebellar hemisphere connect it with the cerebrum, with its fellow, and with the medulla oblongata of the same side.

middle
peduncle,

The description already given of the *middle peduncle*, both here and with the pons, will suffice for the notice of its fibres.

of upper,

The fibres of the *upper peduncle* (fig. 38, *f*) are continued into the optic thalamus, and thus form part of the diverging cerebral set of fibres; but before they reach their final destination there is a partial decussation with the fibres of the opposite peduncle, so that some from the right half of

* This intercommunication was known to Reil, and was named "ansa" by him, but the decussation has been noticed more recently by Stilling, *Ueber den Bau des Hirnknotens*: 1846.

the cerebellum are continued to the left half of the cerebellum, and vice versa.

The fibres of the *lower peduncle* enter the medulla oblongata (fig. 33, *n*), and connect the cerebellum with all three portions of the half of the medulla of the same side; and so, indirectly, with all the corresponding half of the cord, except the small posterior median column: for fibres connect it with the anterior pyramid, with the lateral tract or column, and with the restiform body.

The *dentate body* (*corpus dentatum*) is contained in the white fibres of the cerebellum, and has the same structure as the like part in the corpus olivare of the medulla oblongata. This body measures three-fourths of an inch from before backwards, and is situate near the inner part of the white centre. It consists of a small capsule which, when cut across, appears as a thin, wavy grayish-yellow line; this bag is open at the anterior part, and encloses a nucleus of whitish substance. Through its anterior aperture issues a band of fibres from the nucleus to join the superior peduncle.

Dissection.—One other section must be made to show the fourth ventricle and the structure of the vermiform process. Let the knife be carried vertically through the centre of the vermiform process (the cerebellum still resting on its under surface), and then, on separating the halves of the cerebellum, the structure of its central uniting part, as well as the boundaries of the fourth ventricle may be observed.

Structure of the vermiform process (fig. 37).—The vermiform processes (upper and lower) of the cerebellum are united in one central part, which connects together the hemispheres. Internally the structure of this connecting piece is the same as that of the rest of the cerebellum, viz., a central white portion with lateral offsets for the laminae. Here the branching appearance of a tree (*arbor vitæ*) is best seen, in consequence of the central parts being longer, and the laminae more divided.

The **FOURTH VENTRICLE** (*fossa rhomboidalis*) is a space between the cerebellum and the posterior surface of the medulla oblongata and pons (fig. 37). It has the form of a lozenge, with the points placed upwards and downwards. The upper angle reaches as high as the upper border of the pons; and the lower, to a level with the inferior part of the olivary body. Its greatest breadth is at the spot where the peduncles of the cerebellum are connected with the medulla

and lower.

Corpus dentatum.

Situation and

structure.

Dissection

Vermiform process is like other parts.

Fourth ventricle.

Form and extent,

breadth,

and pons ; and a transverse line in this situation would divide the hollow into two triangular portions—upper and lower. The lower half has been named *calamus scriptorius* from its resemblance to a writing pen.

Lateral boundary. The *lateral boundaries* are more marked at the upper than at the lower part. For about half way down, the cavity is limited on each side by the superior peduncle of the cerebellum, which projecting over it forms part of the roof ; and along the lower half lies the eminence of the restiform body.

Roof. The *roof* of the space is somewhat arched, and is formed above by the valve of Vieussens, and the under part of the vermiform process ; and below, by the reflection of the pia mater from the spinal cord to the surface of the vermiform process, as well as by the thin nervous stratum of the ligula (p. 207).

Floor. The *floor* of the ventricle corresponds with the posterior surfaces of the medulla oblongata and pons, and is grayish in colour. Along its centre is a median groove, which ends below, at the point of the calamus and within the swollen part of the posterior pyramid, in a minute hole,—the aperture of the canal of the cord. On each side of the groove is a spindle-shaped elevation, the *fasciculus s. eminentia teres*.

Parts in it are, median fissure, and central canal. This eminence reaches the whole length of the floor, and is pointed and little marked inferiorly, where it is covered by gray substance ; but it becomes whiter and more prominent superiorly, and its widest point is opposite the attachment of the crus cerebelli. It is formed by the fibres of the medulla oblongata derived from the lateral tract and the restiform body, which ascend to the cerebrum.

Fossæ, The outer border of the eminence is limited externally by a slight groove, which (in some bodies well marked) will point out the position of two fossæ (fovea anterior et posterior). The *posterior fossa* is below near the beginning of the groove, and the *anterior* is opposite the crus cerebelli. At the top of the anterior fossa is a collection of very dark gray substance, which has a bluish appearance as it is seen through the thin stratum covering it, and is named *locus cæruleus* ; * from it a bluish streak (*tænia violacea*) is continued upwards, at the outer edge of the eminentia teres, to the opening in the top of the fourth ventricle.

White striæ. Crossing the floor on each side, opposite the lower border

* The term locus cæruleus seems to be applied to the spot, for the dark vesicular matter in it has been named *substantia ferruginea*.

of the pons, are some white lines, which vary much in their arrangement, and sometimes are not to be recognised: they issue from the central median fissure, and enter the auditory nerve (p. 202); but one may be seen sometimes to enter the locus cæruleus.

Besides the objects above mentioned, there are other eminences in the floor of the ventricle indicating the position of the nuclei of origin of certain nerves.

In the lower half of the ventricle—the part called *calamus scriptorius*—are three slight eminences on each side for the ninth, eighth, and auditory nerves:—One of these, viz., that for the ninth nerve, is close to the middle line below, and corresponds with the lower pointed part of the fasciculus teres. The other two are outside the fasciculus, and are placed in a line one above another, but separated by a well-marked groove (*fovea posterior*); the lower of the two is the nucleus of the vagus and the glosso-pharyngeal, and the upper is the nucleus of the auditory nerve. Running into the lower part of the vagus nucleus, is the nucleus of the accessory portion of the spinal accessory nerve. (See p. 203.)

In the upper half of the space some other nerves take their origin from nuclei, but there is only one projection. This is situate over the common nucleus of the sixth and the facial nerve: it is a half globular elevation on the outer part of the *eminentia teres*, about a line above the white cross stris on the floor, and close behind the *fovea anterior*.

The fourth ventricle communicates at the upper part with the third ventricle through the Sylvian aqueduct; and with the subarachnoid space of the cord and brain, through an aperture in the pia mater of the roof intervening between the medulla and the cerebellum: laterally, the ventricular space is extended for a short distance between the cerebellum and the side of the medulla oblongata.

The lining of the other ventricles is prolonged into this by the aperture of communication with the third. Covering the floor is a columnar epithelium, which is continuous with that in the upper part of the central canal of the spinal cord (Fig 34, n). (Clarke.)

In this ventricle is a vascular fold, or a *choroid plexus*, on each side, similar to the body of the same name in the other ventricles. It is attached to the inner surface of the membrane (*pia mater*) which closes the ventricle between the medulla and the cerebellum, and it extends upwards on the side. Its vessels are supplied by the inferior cerebellar artery.

Eminences of nerve nuclei.

In lower half;
nuclei of the ninth,

of the vagus, and glosso-pharyngeal. Auditory nucleus, and that for the spinal accessory.

In upper half,
the nucleus of the sixth and facial.

Openings of the ventricle.

Its lining and epithelium.

Choroid plexus of the cavity.

Gray matter
forms sur-
face stratum.

Gray matter of fourth ventricle.—The gray matter forms a surface-covering for the floor of the fourth ventricle. It is continuous below with the central gray matter of the cord, and extends upwards to the aqueduct of Sylvius. (See also p. 212).

Special deposits.

The special collections or nuclei have been referred to already (p. 213).

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TABLE OF THE CHIEF ARTERIES OF THE HEAD AND NECK.

[illegible]

VEINS OF THE HEAD AND NECK.

TABLE OF THE CHIEF VEINS OF THE HEAD AND NECK.

Brachio-cephalic is formed by the union of	Internal jugular . . .	{	1. Lateral sinus	{ Superior longitudinal sinus inferior longitudinal sinus straight sinus occipital sinuses ophthalmic vein superior petrosal inferior petrosal.
			2. ascending pharyngeal .	{ Meningeal branches pharyngeal.
			3. lingual . . .	{ Superficial dorsal lingual raaiue.
			4. facial . . .	{ Angular { Supraorbital frontal palpebral nasal.
				inferior palpebral
				dorsal and lateral nasal veins.
			5. occipital . . .	{ anterior internal maxillary { Alveolar branches infraorbital descending palatine naso-palatine vidian.
				coronary . . . { superior inferior
			6. superior thyroid.	{ buccal masseteric labial submental inferior palatine tonsillitic glandular.
			7. middle thyroid . . .	{ Mastoid vein cervical.
			1. Vertebral . . .	{ Thyroid laryngeal.
			2. external jugular . . .	{ Spinal deep cervical ascending cervical.
				1. Internal maxillary . . . { Middle meningeal inferior dental deep temporal pterygoid masseteric.
				2. temporal { Anterior posterior middle temporal parotid anterior auricular transverse facial.
				3. posterior auricular . . { Auricular stylo-mastoid.
				4. branch to the internal jugular.
				5. suprascapular . . . { Suprascapular infraspinous.
subclavian . . .	{	3. anterior jugular.	6. transverse cervical . .	{ Superficial cervical posterior scapular.

TABLE OF THE CRANIAL NERVES.

1. First nerve . . . Filaments to the nose.
 2. Second nerve . . . To retina of the eyeball.
 3. Third nerve . . . To muscles of the orbit.
 4. Fourth nerve . . . To superior oblique muscle.

5. Fifth or tri-facial nerve .	Ophthalmic . . .	Meningeal		
		lachrymal . . .	{	Lachrymal palpebral.
		frontal . . .	{	Supraorbital supratrochlear.
	ophthalmic or lenticular ganglion . . .	nasal . . .	{	To lent. ganglion ciliary nerves infratrochlear nasal.
		Connecting branches	{	To nasal nerve to the third nerve to sympathetic.
		Ciliary nerves.		
	Superior maxillary . . .	Orbital branch . . .	{	Malar temporal.
		to Meckel's ganglion posterior dental anterior dental infraorbital.		
	Meckel's ganglion . . .	Internal branches . . .	{	Nasal naso-palatine.
		ascending . . .	{	To the orbit.
		descending . . .	{	Anterior palatine posterior external.
		posterior . . .	{	Vidian pharyngeal.
	Inferior maxillary . . .	Small or muscular part . . .	{	deep temporal masseteric buccal pterygoid.
		large or sensory part	Auriculo-temporal . . .	{ Articular, and to meatus parotid auricular temporal.
			gustatory . . .	{ To submaxillary and sublingual ganglia to hypoglossal to the tongue.
			inferior dental . . .	{ Mylo-hyoid labial incisor.
	Otic ganglion . . .	Connecting branches	{	To Jacobson's nerve to the fifth and sympathetic.
		Branches for muscles.		
	Submaxillary ganglion . . .	Connecting branches branches to the glands and the mucous membrane of the mouth.	{	To the gustatory, chorda tympani, and sympathetic.

TABLE OF CRANIAL NERVES—*continued.*

6 Sixth nerve

To external rectus.

7. Seventh nerve.	{	Portio dura . .	{	Connecting branches .	{	To join auditory to Meckel's ganglion	
				tympanic and sympathetic nerves			
		the chorda tympani.					
		Branches for distribution .	{	Posterior auricular			
	digastric branch						
	stylo-hyoid branch						
{		temporo-facial .	{	Temporal malar			
	infraorbital.						
{	cervico-facial .	{	Buccal				
	supramaxillary						
inframaxillary.							
{	portio mollis	{	To the portio dura				
			nerve to cochlea.				
{	nerve to vestibule	{	To the common sac				
			to the saccule				
to the semicircular							
canals.							

8. Eighth nerve.

pneumo-gastric

Glosso-pharyngeal

Glosso-pharyngeal	{	Connecting branches	{	To vagus to sympathetic	{	Joins otic ganglion, supplies tympanum	
		Branches for distribution	{	To carotid artery to the pharynx tonsillitic branches muscular lingual.			
pneumo-gastric	{	Connecting branches	{	To glosso-pharyngeal sympathetic and auricular nerves to the hypoglossal.	{	External laryngeal ascending { to the mucous membrane descending { to join the inferior laryngeal.	
				Pharyngeal nerve.			
		Branches for distribution	{	superior laryngeal			{
				cardiac nerves			
	{	Connecting branches	{	To pneumo-gastric to the cervical plexus	{	Cardiac oesophageal, tracheal to constrictor and muscles of larynx to join superior laryngeal	
				Branches for distribution			{

Ninth or hypoglossal nerve.

Connecting branches .	{ To the pneumo-gastric nerve to the sympathetic to loop of atlas to gustatory nerve.	
	{ Descendens noni thyro-hyoid nerve to the lingual muscles and tongue	

TABLE OF THE SPINAL AND SYMPATHETIC NERVES OF THE HEAD
AND NECK.

Spinal Nerves.

The cervical spinal nerves divide into	Anterior branches	The first four form the CERVICAL PLEXUS, which gives off	Superficial ascending	{ Small occipital nerve great auricular superficial cervical
			superficial descending	{ Supraacromial supraclavicular suprasternal
			deep internal	{ To the pneumo-gastric to the hypoglossal to the sympathetic to rectus major muscle to diaphragm nerves to descendens noni
				{ To join the spinal accessory to the sterno-mastoideus to the trapezius to the levator anguli scapulae
		The last four and first dorsal form the BRACHIAL PLEXUS, which gives off	Branches above the clavicle	{ The rhomboid nerve to the phrenic nerve suprascapular nerve subclavian branch posterior thoracic or respiratory to the scaleni muscles.
			branches below	{ Are dissected with the upper limb.
	posterior branches	Are distributed to the muscles of the back, and give off cutaneous nerves		

Sympathetic Nerve.

The sympathetic nerve has in the neck.	1. Superior cervical ganglion has	Ascending branches, which unite in plexuses	Carotid plexus which gives	{ Branch to tympanic plexus to the vidian to the sixth and fifth cranial nerves.
			cavernous plexus, which gives branches	{ To the third cranial nerve to the fourth cranial nerve to the fifth and lenticular ganglion to the carotid artery and branches.
		external branches	{ To join pneumo-gastric and hypoglossal nerves to the spinal nerves.	
		internal branches	{ Pharyngeal branches superficial cardiac nerve.	
		branches to vessels	Nervi molles.	
	2. Middle cervical ganglion	External branches	To the spinal nerves.	
		internal	{ Middle cardiac nerve to supply thyroid body and join the external laryngeal.	
	3. Inferior cervical ganglion	Anterior branches	To the subclavian artery.	
		external	{ To the spinal nerves forming vertebral plexus.	
		internal	Inferior cardiac nerve.	

CHAPTER III.

DISSECTION OF THE UPPER LIMB.

SECTION I.

THE WALL OF THE THORAX AND THE AXILLA.

Directions
for the dis-
section.

THE parts included in this section, viz., the wall of the chest and the axilla, are to be learnt within a fixed time, in order that the examination of the thorax may be undertaken. Whilst the dissection of the thorax is in progress, the student will have to discontinue his labours on the upper limb ; but, on the completion of that cavity, he must be ready to begin the part of the back that belongs to him.

Position of
the body.

Position.—Whilst the body lies on the back, the thorax is to be raised to a convenient height by a block, and the arm, being slightly rotated outwards, is to be placed at a right angle to the trunk.

Directions.—Before the dissection is begun, attention should be given by the student to the chief depressions on the surface, to the prominences of muscles, and to the projections of the bones ; because these serve as guides to the position of objects beneath the skin.

Marking of
the surface.
Arm-pit.

Surface-marking.—Between the arm and the chest is the hollow of the arm-pit, in which the large vessels and nerves of the limb are lodged. The extent of this hollow may be seen to vary much with the position of the limb to the trunk ; for in proportion as the arm is elevated, the fore and hinder boundaries are carried upwards and rendered tense, and the depth of the space is diminished. In this spot the skin is of a dark colour, and is furnished with hairs and large sweat glands.

Head of
bone to be
felt.

If the arm is forcibly raised and moved in different directions, whilst the fingers of one hand are placed in the arm-pit, the head of the humerus may be recognised.

Shoulder
arch of
bone.

On the outer side of the limb is the prominence of the shoulder ; and immediately above it is an osseous arch,

which is formed internally by the clavicle, and externally by the spine and the acromion process of the scapula. Continued downwards from about the middle of the clavicle, between the pectoral and deltoid muscles, is a slight depression, in which the coracoid process can be felt near that bone. A second groove is sometimes seen extending outwards from the sternal end of the clavicle; this corresponds with the interval between the clavicular and sternal origins of the great pectoral muscle.

Intermuscular depression.

Along the front of the arm is the prominence of the biceps muscle; and on each side of the muscle is a groove, which subsides inferiorly in a depression in front of the elbow joint. The inner of the two grooves is the most marked, and indicates the position of the brachial vessels.

Arm: its prominence and groove.

If the elbow joint be semiflexed the prominences of the outer and inner condyles of the humerus will be rendered evident, especially that on the inner side of the limb. Below the outer condyle, and separated from it by a slight interval, is the projection of the head of the radius, which may be recognised by rotating this bone, the fingers at the same time being placed over it. At the back of the articulation is the prominence of the olecranon.

Prominences of bone around the elbow joint.

Dissection.—The dissection is to be commenced by raising the skin from the side of the chest and the arm-pit, so as to lay bare the great pectoral muscle and the hollow of the axilla beneath it. These parts may be denuded by means of the following incisions:—One is to be made along the middle of the sternum (the whole length). Another is to be continued along the clavicle for the inner two-thirds of that bone; thence down the front of the arm rather beyond the anterior fold of the arm-pit; and lastly it is to be turned across the inner surface of the arm as far as the hinder fold of the axilla. From the xiphoid cartilage another incision is to be directed outwards over the side of the chest, as far back as to a level with the posterior fold of the arm-pit. The flap of skin now marked out should be reflected outwards, but it should be left attached to the body, in order that it may be used afterwards for the preservation of the part.

Dissection to raise the integument.

The *subcutaneous fascia* of the thorax resembles the same structure in other parts of the body; but in this region the superficial layer does not contain much fat.

Fascia, superficial,

Beneath the subcutaneous layer is a *deeper* and stronger *special fascia* which closely invests the muscles, and is continuous with the deep fascia of the arm. It is thin on the

and deep:

where
thickest.

side of the chest, but becomes much thicker where it is stretched across the axilla. An incision through it, over the arm-pit, will render evident its increased strength in this situation, and its connections with the muscular folds of the axilla which it incases ; and if the fore finger be introduced through the opening, some idea will be gained of its capability of confining an abscess in that hollow.

Dissection
of cutaneous
nerves of
the chest,

Dissection.—The cutaneous nerves of the side of the chest are to be next sought in the fat. Some of these (from the cervical plexus) will be found crossing the clavicle at the middle, and at the inner part. Others (anterior cutaneous of the thorax) appear at the side of the sternum,—one from each intercostal space. And others (lateral cutaneous of the thorax) should be looked for along the side of the chest, about one inch below the anterior fold of the axilla, there being one from each intercostal space except the first : as soon as the last mentioned nerves appear through the muscles, they are divided into an anterior and a posterior branch.

and of the
nerve of
Wrisberg.

In the highest two nerves the posterior branches are larger than in the rest ; they are to be followed across the arm-pit, and a junction is to be found there with a branch (nerve of Wrisberg) of the brachial plexus.

Descending
cutaneous
nerves of
cervical
plexus.

Cutaneous nerves of the cervical plexus.—These cross the clavicle, and are distributed to the integuments over the pectoral muscle. The most internal branch (sternal) lies near the inner end of the bone, and reaches but a short distance below it. Other branches (clavicular), two or more in number, and of larger size, cross the centre of the clavicle, and extend to near the lower border of the pectoralis major ; these join one or more of the anterior cutaneous nerves of the thorax.

Cutaneous
branches of
the inter-
costal
nerves

The *cutaneous nerves of the thorax* are derived from the trunks of the intercostal nerves between the ribs. Of these there are two sets :—One set, the lateral cutaneous nerves of the thorax, arise from the trunks of the nerves about mid-way between the spine and the sternum. The other set, the anterior cutaneous nerves of the thorax, are the terminations of the same intercostal trunks at the middle line of the body.

are in two
rows.

One along
middle line.

The *anterior cutaneous* nerves, after piercing the pectoral muscle, are directed outwards in the integuments as slender filaments. The offset of the second nerve joins a cutaneous branch of the cervical plexus ; and the others supply the mammary gland and the integuments. Small cutaneous

branches of the internal mammary vessels are found with these nerves.

The *lateral cutaneous* nerves come with companion vessels between the digitations of the serratus muscle, and divide immediately into an anterior and a posterior branch. There is not usually any lateral cutaneous nerve to the first intercostal trunk; and the cutaneous nerve of the second intercostal trunk wants commonly the anterior of the two offsets into which the other lateral cutaneous nerves bifurcate.

a. The *anterior offsets* bend forwards over the pectoral muscle, and end in the mammary gland and the integuments. The lowest give twigs also to the digitations of the external oblique muscle.

b. The *posterior offsets* are distributed to the integuments over the latissimus dorsi muscle and the back of the scapula. The branch of the second intercostal nerve is larger than the rest, and, perforating the fascia of the axilla, supplies the integument of the arm (p. 289), from which circumstance it is named *intercosto-humeral*. As it crosses the axilla it is divided into two or more pieces, and is connected to the nerve of Wrisberg by a filament of variable size. The branch of the third intercostal gives filaments likewise to the arm-pit and the inner part of the arm.

The MAMMA, or the breast, is the gland for the secretion of the milk, and is situate on the front of the chest, though somewhat towards the lateral aspect.*

The gland is hemispherical in form, and is placed over the great pectoral muscle, but it is rather most prominent at the inner and lower parts. Its dimensions and weight vary greatly. In a breast that is not enlarged by lactation the width is commonly about four inches; and it extends longitudinally from the third to the sixth or seventh rib, and transversely from the side of the sternum to the axilla. Its depth is about one inch and a half. The weight of the breast ranges from six to eight ounces.

Nearly in the centre of the gland (rather to the inner side of the centre) is the conical or cylindrical projection of the nipple or mamilla. This prominence is about half an inch or rather more in length, is slightly turned outwards, and presents in the centre a shallow depression, where it

* If the student has a male body, he may disregard the description of the breast; and if the body is a female, he may set aside the breast for a more convenient examination of its structure.

- and the areola. is likewise rather redder. Around the nipple is a coloured ring,—the *areola*, about an inch in width, whose tint is influenced by the complexion of the body; and it is altered during the times of menstruation, pregnancy, and lactation. The skin of the nipple and areola is provided with numerous papillæ and lubricating glands; and on the surface are some tubercles marking the position of the ducts of those glands.
- Colour is altered.
- Skin has glands.
- Breast of the male. In the male the mammary gland resembles that of the female in general form; for it is prominent though in a much less degree, and it possesses a small nipple, which is surrounded by an areola provided with hairs. The glandular or secretory structure is very imperfect.
- Structure. *Structure*.—In its texture the mamma resembles those compound glands that are formed by the vesicular endings of branched ducts. During lactation the glandular mass is of a reddish white colour. It consists of small vesicles, which are united to form lobules and lobes. Connected with each lobe is an excretory or lactiferous duct; and the whole is surrounded and bound together by areolar tissue.
- Investing A layer of areolar tissue, containing fat, surrounds the gland, and penetrates into the interior, subdividing it into lobes. Some fibrous septa fix the gland to the skin, and support it; these are the *ligamenta suspensoria* of Sir A. Cooper. In the ultimate structure of the gland, in the nipple, and in the areola, there is not any fatty substance.
- and fibrous tissue.
- Texture and form of the vesicles. *Vesicles*.—The little vesicles or cells at the ends of the most minute ducts are lenticular or rounded in shape, and when filled with milk or mercury are just visible to the naked eye, being about the size of a small pinhole in paper. (Cooper.) Each is surrounded externally by a close vascular network.
- Vesicles form lobules, and lobules lobes. *Lobules and lobes*.—A collection of the vesicles around their duct forms the smallest division of the gland, viz., lobules or glandules, which vary in size from a pin's-head to a small tare. By the union of the lobules the lobes are produced, of which there are about twenty altogether, and each is provided with a distinct duct.
- Lactiferous ducts; The *ducts* issuing from the several lobes are about twenty in number, and are named from their office *galactophorous*; they converge to the areola, where they swell into oblong dilatations or reservoirs (*sacculi*) of one sixth to one third of an inch in width. Onwards from that spot the ducts become straight, and are continued through the nipple, nearly parallel to one another and gradually narrowing in

size, to open on its summit by apertures varying from the size of a bristle to that of a common pin. open on end of nipple.

Like many other excretory ducts, the milk tubes consist of an external or fibrous, and an internal or mucous coat; they are sheathed also by a scaly or pavement epithelium, but in the reservoirs the epithelial lining is said to be columnar. In the nipple the ducts are surrounded by elastic fibrous tissue. Structure.

Some of the lubricating glands beneath the skin of the nipple and areola are simple sebaceous glands, but others are larger aggregate glands that open in the tubercles before mentioned. Small glands of skin.

Bloodvessels, nerves, and lymphatics.—The arteries of the breast are supplied by the axillary, internal mammary, and intercostal arteries, and enter both surfaces of the organ. The vessels on the cutaneous surface supply branches to the nipple, which pass from base to apex, being nearly parallel. Arteries of the gland

The veins, after issuing from the substance of the breast, are thus disposed:—some form a plexus on the anterior aspect with a circle around the areola, and end principally in the axillary and internal mammary trunks; but others enter one or more of the intercostal veins, or ascend over the clavicle to join the veins of the neck. In the nipple the veins have an arrangement like that of the arteries. and veins: in nipple.

The nerves are supplied from the anterior and lateral cutaneous nerves of the thorax, viz. those of the third, fourth, and fifth intercostal nerves. Nerves.

The lymphatics pass from either the inner or the outer part of the gland: those at the inner side accompany the branches of the internal mammary artery, and open into the anterior mediastinal glands: but those on the outer side reach the axillary glands. Lymphatics.

Dissection.—With the arm in the same position with respect to the trunk, the student is first to remove the fascia and the fat from the surface of the great pectoral muscle. In cleaning the muscle the scalpel should be carried in the direction of the fibres, viz., from the arm to the thorax; and the dissection may be begun at either the upper or lower border of the muscle, according as the one or the other may be the most convenient on the opposite sides of the body. Dissection of pectoral muscle

The fascia and the fat are then to be taken from the arm-pit, but the numerous vessels, nerves, and glands contained in the space are to be left uninjured. The dissection will be best begun at the outer part, by removing the fascia from the large axillary vessels, where these are about to quit the space and enter the arm. Following upwards those bloodvessels, the student will find the branches that are and the arm-pit.

directed towards the chest, viz., the long thoracic under cover of the anterior boundary, and the circumflex and subscapular vessels and nerves on the posterior boundary of the axilla. Some arterial twigs enter the axillary glands, and a few should be traced out. In taking away the fascia and fat from the posterior boundary of the space, so as to follow the muscles to their insertion into the humerus, a small nerve (internal cutaneous of the musculo-spiral) should be looked for near the great vessels.

Nerves.

The large nerves of the brachial plexus are to be defined : with moderate caution they cannot be injured.

THE AXILLA.

Situation and form of the arm-pit.

The axilla, or arm-pit, is the hollow between the arm and the chest. It is somewhat conical in form, and its apex is directed upwards to the root of the neck. The space is larger near the thorax than at the arm, and its boundaries are as follows :—

Boundaries.

Boundaries.—In front and behind the space is limited for the most part by the muscles passing from the trunk of the body to the upper limb ; and the folds of the axilla are constructed by the unattached parts of those muscles.

The pectoral muscles in front,

In the anterior boundary are the two pectoral muscles, but these take unequal shares in its construction in consequence of the difference in their size and shape :—thus the pectoralis major extends over the whole front of the space, reaching from the clavicle to the lower edge of the anterior fold ; whilst the pectoralis minor, which is a narrow muscle, corresponds only with the middle part or third of that fold.

and latissimus, teres, and subscapularis behind.

In the posterior boundary, from above downwards, are the subscapularis, the teres major, and the latissimus dorsi muscle : this boundary reaches lower than the anterior, especially near the humerus, and its lower margin, which is formed mostly by the latissimus dorsi, projects forwards beyond the level of the subscapularis.

Parts at the inner and outer sides.

On the inner side of the arm-pit are the first four ribs, with their intervening intercostal muscles, and the part of the serratus magnus that takes origin from those bones. On the outer side the space has but small dimensions, and is limited by the humerus, and by the biceps and coracobrachialis muscles.

Situation of the apex

The apex of the hollow is situate between the clavicle, the upper margin of the scapula, and the first rib ; and the

fore finger may be introduced into the space for the purpose of ascertaining the depth, and the upper boundaries. The base or widest part of the conically-shaped interval is turned downwards, and is closed by the thick aponeurosis that reaches from the anterior to the posterior fold.

Contents of the space.—In the arm-pit are contained the axillary vessels and the brachial plexus, with their branches; some branches of the intercostal nerves; together with lymphatic glands, and a large quantity of loose areolar tissue and fat. The position of all these, with reference to the boundaries of the space, is to be carefully studied.

Position of the trunks of the vessels and nerves.—The large axillary vessels cross the outer portion of the space in passing from the neck to the upper limb. The part of the vessels that can be seen now, lies close to the humerus, reaching beyond the line of the anterior fold of the arm-pit, and is covered only by the common superficial layers, viz. the skin, the fatty or superficial fascia, and the deep fascia. Behind the vessels are the subscapularis and the tendons of the latissimus and teres muscles. To their outer side is the coraco-brachialis muscle. On looking into the arm-pit from below, the axillary vein will be found to lie to the thoracic side of the artery, and to conceal it. After the vein has been drawn aside, the arterial trunk will be seen to lie amongst some of the large nerves of the upper limb, having the median nerve to the outside; the ulnar, and the small nerve of Wrisberg to the inner side; the internal cutaneous generally in front of, and the musculo-spiral nerve behind it. This part of the artery gives branches to the side of the chest and the shoulder. The vein receives likewise some branches in this spot.

Position of the branches of the vessels and nerves.—The several branches of the trunks of the vessels and nerves have the undermentioned position with respect to the boundaries. Close to the anterior fold, and rather concealed by it, the long thoracic artery extends to the side of the chest; and taking the same direction, though nearer the middle of the arm-pit, are a small artery and vein (external mammary). Extending along the posterior fold, within its lower margin and in contact with the edge of the subscapularis muscle, are the subscapular vessels and nerves; and near the humeral end of the subscapularis the posterior circumflex vessels and nerve bend backwards beneath the large axillary trunks. On the inner boundary, near the upper part, are a few inconsiderable branches of the superior

thoracic artery, which ramify on the serratus muscle; but these are commonly so unimportant, that this part of the axillary space may be considered free from vessels with respect to any surgical operation. Lying on the surface of the serratus magnus, is the nerve to that muscle; and perforating the inner boundary of the space, are the lateral cutaneous nerves of the thorax,—two or more offsets of which are directed across the axilla to the arm, and receive the name intercosto-humeral.

Lymphatic glands of the axilla:

The *lymphatic glands* of the axilla are arranged in two sets: one set lies along the inner side of the bloodvessels; and the other occupies the lower and hinder parts of the space, lying near and along the posterior boundary. Commonly they are ten or twelve in number; but in number as well as in size they vary much. The glands by the side of the bloodvessels receive the lymphatics of the arm; and those along the hinder boundary are joined by the lymphatics of the fore part of the thorax and of the posterior surface of the back, as well as by some of those of the mamma. The efferent ducts of all unite to form a trunk, which opens into the lymphatic duct of the same side in the neck, or into the subclavian vein by a separate tube. Small vascular twigs from the branches of the axillary vessels are furnished to the glands.

end in the lymphatic duct.

Pectoralis muscle.

Origin from chest and clavicle.

The PECTORALIS MAJOR is a muscle of a triangular shape, which has its base at the thorax and its apex at the arm. It *arises* internally from the front of the sternum, and the cartilages of the true ribs except the last; superiorly from the sternal half of the clavicle; and inferiorly from the aponeurosis of the external oblique muscle of the abdomen. From this wide origin the fibres take different directions,—those from the clavicle being inclined obliquely downwards, and those from the lower ribs upwards beneath the former; and all end in a tendon, which is *inserted* into the outer edge of the bicipital groove of the humerus for about two inches (Fig. 72, ¹).

Insertion into the humerus.

Parts covering it,

and along the borders.

This muscle bounds the axilla anteriorly, and is connected sometimes to its fellow by fibres in front of the sternum. Besides the superficial structures and the mamma, the platysma covers the pectoralis major close below the clavicle. A lengthened interval, which corresponds with a depression on the surface, separates the clavicular from the sternal attachment. One border (upper) is in contact with the deltoid muscle, and with the cephalic vein and a small artery; and the lower border forms the margin of the anterior fold of

the axilla. The parts covered by the muscle will be seen subsequently.

Dissection.—The great pectoral muscle is to be cut across now in the following manner.

First, only the clavicular part is to be divided, so that branches of a nerve and artery to the muscle may be looked for, and a thin membrane around the bloodvessels may be prepared. By raising the cut part of the muscle, and carefully removing the fat, and a piece of fascia prolonged from the upper border of the small pectoral muscle, the membranous sheath (costo-cornuoid), which covers the axillary vessels and nerves, will be seen close to the clavicle; at the same time the cephalic vein will be detected as it crosses inwards to the axillary vein. A branch of nerve (anterior thoracic), and the acromial thoracic artery perforate the tube of membrane, and are to be followed to the pectoral muscles.

The remaining part of the pectoralis major may be cut about its centre, and the pieces may be thrown inwards and outwards. Any fat coming into view is to be removed, and the insertion of the tendon of the pectoralis is to be followed to the humerus. The parts beneath the pectoral muscle are now laid bare.

Insertion of the pectoralis.—The tendon of the pectoralis consists of two parts, anterior and posterior, at its attachment to the bone; the anterior receives the clavicular and upper sternal fibres, and joins the tendon of the deltoid muscle; and the posterior gives attachment to the lower ascending fibres. The tendon is from two inches to two inches and a half wide, and sends upwards one expansion over the bicipital groove to the capsule of the shoulder joint, another backwards to line the groove, and a third to the fascia of the arm.

Parts covered by the pectoralis.—The great pectoral muscle covers the pectoralis minor, and forms alone, above and below that muscle, the anterior boundary of the axilla. Between the pectoralis minor and the clavicle it conceals the subclavian muscle, the sheath containing the axillary vessels, and the branches that perforate the sheath. Below the small pectoralis it lies on the side of the chest, on the axillary vessels and nerves, and, near the humerus, on the biceps and coraco-brachialis muscles.

The PECTORALIS MINOR resembles the preceding muscle in shape, and is extended like it from the thorax to the arm. Its *origin* is connected by slips with the front and the upper border of the third, fourth, and fifth ribs, external to

Cut clavicular part of the pectoral.

Divide the rest of the muscle and see its insertion.

Tendon of insertion of pectoralis.

Parts covered by the muscle.

Pectoralis minor arises from chest;

is not any muscle immediately in contact with it behind, for the artery is placed across the top of the axillary space, particularly when the limb is in the position required by the dissection.

and beyond
the muscle.

Beyond the *pectoralis minor* the artery is concealed in part by the lower border of the great pectoral muscle, but thence to its termination it is covered only by the integuments and the fascia. Beneath it are the subscapularis muscle and the tendons of the latissimus and teres. To the outer side is the coraco-brachialis muscle. Here the artery lies in the midst of the large trunks of nerves into which the brachial plexus has been resolved:—On the outer side is the median nerve, with the external cutaneous for a short distance; and on the inner side are the ulnar, sometimes the internal cutaneous, and the nerve of Wrisberg. Behind are the musculo-spiral and circumflex nerves, the latter extending only as far as the border of the subscapular muscle. The axillary vein remains as above on the thoracic side of the artery.

Position of
nerves

and vein to
it.

Branches
are supplied
to the tho-
rax

and the
shoulder.

Upper
thoracic.

Acromial
thoracic is
large,

and supplies
thorax and
shoulder.

Inferior
acromial

The branches of the axillary artery are furnished to the wall of the thorax and to the shoulder. The thoracic branches are four in number; two of these (superior and acromial thoracic) arise from the artery above the *pectoralis minor*, one (alar thoracic) beneath the muscle, and one (long thoracic) at its lower border. Three branches are supplied to the shoulder, viz., one subscapular and two circumflex; the first springs opposite the edge of the muscle of the same name, and the others wind round the neck of the humerus.

1. The *superior thoracic* branch is the highest offset of the artery, and arises opposite the first intercostal space; it is very small generally, and ramifies on the side of the chest anastomosing with the intercostal arteries.

2. The *acromial thoracic* branch (fig. 44) is a short trunk on the front of the artery, which appears at the upper border of the *pectoralis minor*, and opposite the interval between the large pectoral and deltoid muscles. Its branches are directed inwards to the two pectoral, and outwards to the deltoid muscle.

a. The inner or thoracic set, besides supplying the thoracic muscles, give a few offsets to the side of the chest, which anastomose with the intercostal and other thoracic arteries.

b. The outer or acromial set end mostly in the deltoid; but one small artery which is derived from them accompanies

The *inner cord* produces a second anterior thoracic nerve, inner, and the inner head of the median, the internal cutaneous, the nerve of Wrisberg, and the ulnar nerve.

The *posterior cord* furnishes the subscapular branches, and ends in the circumflex and musculo-spiral nerves. posterior cord.

Only the thoracic and subscapular nerves are dissected to their termination at present; the remaining nerves will be seen in the arm. The following are seen, viz.,

The *anterior thoracic* branches are two in number,—outer and inner with respect to the cords of the plexus. two anterior thoracic, outer

a. The *outer* nerve crosses inwards over the axillary artery, to the under surface of the great pectoral muscle in which it ends. On the inner side of the vessel it communicates with the following branch.

b. The *inner thoracic* branch turns upwards between the artery and vein, and after receiving the offset from the other, ends in many branches to the under surface of the pectoralis minor. Some twigs enter the great pectoral muscle, after passing either through the pectoralis minor or above its border. and inner.

The *subscapular nerves* are three in number. Two enter the subscapular muscle, and are named upper and lower from their relative position; and the third is the long subscapular. Three subscapular;

a. The *upper* branch is the smallest, and enters the upper, highest part of the subscapularis muscle.

b. The *lower subscapular* branch (nerve of the teres lower, and muscle) gives an offset to the inferior part of the subscapular muscle, and ends in the teres major. lower, and

c. The *long subscapular* nerve takes the course of the artery (subscapular) along the posterior wall of the axilla, and ends in the latissimus dorsi muscle. long subscapular.

Another small nerve, *nerve to the serratus*, (posterior thoracic, external respiratory, Bell), is seen on the surface of the serratus muscle. It arises above the clavicle (p. 78), from the fifth and sixth cervical nerves;—to reach its destination, it descends behind the axillary artery, and enters that surface of the serratus magnus muscle which is towards the axilla. Posterior thoracic.

The LATISSIMUS DORSI MUSCLE may be examined as far as it enters into the posterior fold of the axilla. Arising from the spine and the back of the trunk, and crossing the lower angle of the scapula, the muscle ascends to be inserted by a tendon into the bottom of the bicipital groove. At its attachment to the bone, the tendon is from one inch and a half Latissimus in the fold of the axilla.

Disposition
of its fibres.

to two inches in depth, and lies in front of the teres; at its lower border aponeurotic fibres connect it with the tendon of the teres, but a well-marked bursa intervenes between the two near the insertion into the bone. The fibres have a cross arrangement in their course to the tendon of insertion; for whilst those that are attached to the lower ribs ascend to the upper edge of the tendon, those from the spines of the dorsal vertebræ descend to the lower edge. Thus the fibres produce a hollow or groove, which lodges the lower border of the scapula and the teres major muscle.

Dissection
of the serratus.

Dissection.—To lay bare the serratus muscle which passes from the side of the chest to the base of the scapula, the arm must be drawn from the trunk, so as to separate the scapula from the thorax. The nerves of the brachial plexus may be cut through, if it is necessary, below the second rib; and the fat and the fascia should be cleaned from the muscular fibres.

Serratus
muscle is
attached to
the ribs and
scapula,

The **SERRATUS MAGNUS MUSCLE** (Fig. 72, ⁴) extends between the scapula and the thorax. It *arises* by nine pointed processes from the outer surface and the borders of the eight upper ribs, about two inches from their cartilages, —the second rib having two pieces; and between the ribs some fibres take origin from the aponeurosis covering the intercostal muscles. The fibres converge towards the base and the angles of the scapula, but from a difference in their direction the muscle appears to consist of three parts. The *upper* part is attached internally to the first two ribs and to an aponeurotic arch between them; and externally, to an impression on the ventral surface of the upper angle of the scapula. A *middle* part, which is very thin, extends from the next two ribs (third and fourth) to the base of the shoulder bone. And a *lower* part, which is the strongest, is connected on the one side with four ribs (fifth, sixth, seventh, and eighth), where it digitates with like processes of origin of the external oblique muscle; and, on the other side, it is fixed into the special surface on the costal aspect of the lower angle of the scapula. The muscle is applied against the ribs and the intercostal muscles, and is partly concealed by the pectoral muscles and the axillary vessels and nerves: in the ordinary position of the arm, the scapula and the subscapularis muscle are in contact with it.

and its
fibres seem
to form
three
parts.

Connections
of the
muscle.

Dissection
of the inter-

Dissection.—The intercostal muscles will be brought into view by detaching the processes of origin of the serratus

from the ribs, and by taking away the loose tissue on the surface. Towards the front of the chest the thin aponeurosis, which is continued forwards from the external intercostal muscle to the sternum, is to be retained. Some of the lateral cutaneous nerves should be preserved.

The INTERCOSTAL MUSCLES are named from their position between the ribs. There are two layers in each space, but neither occupies the whole length of a space; for one layer (the external) ceases in front at the costal cartilages, and the other (internal) extends backwards only to the angle of the ribs. Their number, and their depth and size are determined by the intercostal spaces. The direction of the fibres differs in each stratum; for, whilst the fibres of the external muscle pass very obliquely downwards and forwards, those of the internal layer have an opposite though less oblique direction, so that they cross.

The *external muscle* is fixed to the outer margin of the ribs in each space, and consists of fleshy and tendinous fibres. Posteriorly the fibres begin at or near the tubercle of the rib; and anteriorly they end short of the middle line, but after a different manner in the upper and lower spaces. In the intervals between the true ribs, they cease near the costal cartilages, and a thin aponeurosis is continued onwards from the point of ending to the sternum. In the lower spaces the muscles are continued between the cartilages (Theile), and in the last two they reach the end of the ribs.

Dissection.—The internal intercostal muscle will be seen by cutting through and removing the external layer in one of the spaces, as for instance the second where it is widest; the muscle will be recognised by the difference in the direction of the fibres.

Far back between the two muscles, and close to the rib above, the intercostal nerve and artery will be found. A branch of the nerve to the surface (lateral cutaneous of the thorax) should be followed through the external muscular layer; and the trunk of the nerve is to be traced forwards in one or more spaces to the sternum and the surface of the thorax. The hinder part of these muscles will be seen in the dissection of the back and thorax.

Each *internal intercostal* muscle is attached to the inner border of the ribs bounding the intercostal space. It begins in front at the anterior part of the space, and ceases behind near the angle of the ribs. Behind, the muscles do not end at the same distance from the spine, for the upper and lower

costal
muscles.

Intercostal
muscles are
two layers
in each
space.

Outer layer
is deficient
anteriorly;

difference
above and
below.

Dissection
of deeper
muscle,

of nerves
and vessels.

Inner layer
of the mus-
cles defi-
cient poste-
riorly;
joins inter-
nal oblique
below.

approach nearer than the middle set ; and, in front, in the two lowest spaces, the muscular fibres are continuous with those of the internal oblique of the abdomen. One surface is covered by the external muscle and by the intercostal vessels and nerve ; and the opposite surface is in contact with the pleura.

Dissection
of internal
mammary
vessels.

Dissection.—To bring into view the triangularis sterni muscle and the internal mammary vessels, the cartilages of the true ribs, except the first and seventh, are to be taken away on the right side of the body ;* but the two ribs mentioned are to be left untouched for the benefit of the dissectors of the abdomen and the head and neck. Small arteries to each intercostal space and the surface of the thorax, as well as the intercostal nerves, are to be preserved. The surface of the triangularis sterni will be made apparent, after the removal of the cartilages, by cleaning the loose tissue and fat from it.

Triangularis
sterni

is in the
thorax and
attached to
the ribs.

Conne-
ctions.

Internal
mammary
is a branch
of subcla-
vian ;

courses
through
thorax to
abdomen.

Branches

The TRIANGULARIS STERNI is a thin muscle inside the cavity of the thorax, and beneath the costal cartilages. It arises internally from the side of the xiphoid cartilage, from the side of the sternum as high as the third cartilage, and from the lower three or four true costal cartilages. Its fibres are directed outwards, the upper being most oblique, and are inserted by fleshy fasciculi into all the true ribs except the last two and the first, at the junction of the bone and cartilage, and into an aponeurosis in the intercostal spaces. The muscle is covered by the ribs and the internal intercostal muscles, and by the internal mammary vessels and the intercostal nerves. It lies on the pleura ; its lower fibres are continuous with those of the transversalis abdominis.

The *internal mammary artery* is a branch of the subclavian (p. 74), and enters the thorax beneath the cartilage of the first rib. It is continued through the thorax, lying beneath the costal cartilages and about half an inch from the sternum, as far as the interval between the sixth and seventh ribs ; here it gives externally a large muscular branch (musculophrenic), and passing beneath the seventh rib, enters the sheath of the rectus muscle of the wall of the abdomen. In this course in the chest the artery lies on the pleura and the triangularis sterni, and is crossed by the intercostal nerves. It is accompanied by two veins, and by a chain of lymphatic glands. The following branches take origin in the thorax :—

* On the left side the vessels and the muscle will have been destroyed by the injection of the body.

a. A small branch (*comes nervi phrenici*) arises as soon as the artery enters the chest, and descends to the diaphragm along the phrenic nerve. to phrenic nerve.

b. A few small *mediastinal* branches are distributed to the remains of the thymus gland, the pericardium, and the triangularis sterni muscle. mediastinal.

c. Two *anterior intercostal* branches turn outwards in each space, one being placed on the border of each costal cartilage, and terminate by anastomosing with the aortic intercostal arteries. intercostal, and

d. *Perforating* branches, one or two for each space, pierce the internal intercostal and pectoral muscles, and are distributed on the surface of the thorax with the anterior cutaneous nerves. The lower branches supply the mamma in the female. perforating branches.

e. The *musculo-phrenic* branch courses outwards beneath the cartilages of the seventh and eighth ribs, and enters the wall of the abdomen by perforating the diaphragm. It supplies anterior branches to the lower intercostal spaces, and its termination will be seen in the dissection of the abdominal wall. Musculo-phrenic branch.

Two *veins* accompany the artery; these join into one trunk, which opens into the innominate vein. Veins.

The *intercostal nerves* supply the wall of the thorax, and are seen now in the anterior part of their extent. They are the anterior primary branches of the dorsal nerves. Placed at first between the layers of the intercostal muscles, each gives off the lateral cutaneous nerve of the thorax, about midway between the spine and the sternum: diminished in size by the emission of that offset, the trunk is continued onwards, at first in, and afterwards beneath the internal intercostal muscle, as far as the side of the sternum, where it ends as the anterior cutaneous nerve of the thorax. The intercostal nerves supply branches to the intercostal muscles, and to the triangularis sterni. Intercostal nerves; course, termination, and branches.

The *aortic intercostal arteries* furnish branches to the thoracic wall; they lie with the nerves between the strata of intercostal muscles, and nearer the upper than the lower rib bounding the intercostal space. About the mid point (from before back) of the space the artery bifurcates:—one branch follows the line of the upper rib, and the other descends to the lower rib; both anastomose anteriorly with the intercostal branches of the internal mammary artery. Intercostal arteries are with the nerves, and branch into two.

A small *cutaneous offset* is distributed with the lateral cutaneous nerve of the thorax. Cutaneous branch.

At this stage the thorax and back are dissected.

Directions.—The dissector of the upper limb now waits the appointed time for the examination of the thorax. But as soon as the body is turned he is to take his share in the dissection of the back, and to proceed with the parts marked for him in Chapter V.

After the back is finished, the limb is to be detached from the trunk by sawing the clavicle about the middle, and cutting through the soft parts connected with the scapula.

SECTION II.

SCAPULAR MUSCLES, VESSELS, NERVES, AND LIGAMENTS.

Position.

Position.—After the limb has been separated from the trunk, it is to be placed with the subscapularis uppermost.

Dissection of muscles.

Dissection.—The different muscles that have been traced to the scapula in the dissection of the front of the thorax and the back, are now to be cleaned, and to be followed to their insertion into the bone. A small part of each, about an inch in length, should be left for the purpose of ascertaining more exactly the osseous attachment.

Muscles inserted

The borders and the angles of the scapula have the following muscles connected with them :—

into upper margin of the scapula ;

The *upper margin* of the scapula has but one muscle, the omo-hyoid, attached to it. At its origin that muscle is about half an inch wide, and is connected to the edge of the bone behind the notch, but sometimes to the ligament (posterior special) which converts the notch into a foramen.

into lower margin ;

The *lower margin*, or costa, gives origin to the long head of the triceps, and to some fibres of the teres major ; but these attachments to the bone will be ascertained in the progress of the dissection.

into the base ;

The *base* of the bone has many muscles inserted into it. Between the superior angle and the spine, the levator anguli scapulae is inserted. Opposite the spine, the rhomboideus minor is fixed. And between the spine and the inferior angle the rhomboideus major is attached : the upper fibres of this muscle end often in an aponeurotic arch, and are connected indirectly to the bone by means of an expansion from it. Internal to these muscles, and inserted into the whole extent of the base of the scapula, is the serratus magnus muscle.

On the *angles* of the scapula the fibres of the serratus magnus are collected in this way :—the highest fibres are fixed to the under surface of the upper angle, and the lowest fibres are inserted into an impression on the same aspect of the lower angle. On the outer surface of the inferior angle is the *teres major*, which will be subsequently seen.

into the angles of the bone;

The insertion of the small pectoral muscle into the front of the upper part of the *coracoid process* may be ascertained at this stage of the dissection.

into coracoid process.

Dissection.—By the separation of the serratus from the subscapularis a thin fascia comes into view, which belongs to the last muscle, and is fixed to the bone around its margins. After the fascia has been observed, it may be removed; and the muscle is to be followed forwards to its insertion into the humerus. Next, the axillary vessels and nerves, and the offshoots of these to the muscles, should be well cleaned.

Dissection.

The SUBSCAPULARIS MUSCLE occupies the under surface of the scapula, and is concealed by that bone when the limb is in its natural position. The muscle *arises* from the concave surface on the ventral aspect of the scapula, except at the angles, and this attachment reaches forwards nearly to the neck of the bone; it is attached also to the ridges of the bone by tendinous processes. Externally it is *inserted* by a tendon into the small tuberosity of the humerus and by fleshy fibres into the neck of the bone for nearly an inch below that process.

Subscapularis

fills the hollow of scapula;

is inserted into humerus.

By one surface the muscle bounds the axilla, and is in contact with the axillary vessels and nerves and the serratus magnus. By the other, it rests against the scapula and the shoulder joint; and between its tendon and the root of the coracoid process is a bursa, which communicates generally with the synovial membrane of the shoulder joint. The lower border projects much beyond the bone: it is contiguous to the *teres major*, and comes into contact with the *latissimus dorsi* and the long head of the *triceps*: along this border is the subscapular artery, which here gives backwards its dorsal branch.

Connections.

Dissection.—The subscapular muscle is to be separated next from the bone; and at the same time its tendinous processes of origin, the connection between its tendon of insertion and the capsule of the shoulder joint, as well as the bursa, are to be observed. A small arterial anastomosis on the ventral surface of the bone is to be dissected out as the muscle is raised.

Dissection.

The *infrascapular artery* ramifies on the ventral surface

Small infra-

- scapular artery. of the scapula, and is an offset of the dorsal branch of the subscapular vessel (p. 269). It enters beneath the subscapularis muscle, and forms an anastomosis with small twigs of the supra and posterior scapular branches.
- Position for the shoulder. *Position.*—The examination of the muscles on the opposite surface of the scapula may be next undertaken. For this purpose the scapula is to be turned over ; and a block, which is of sufficient height to allow the shoulder to be made prominent, is to be placed between it and the arm.
- Dissection of the shoulder. *Dissection.*—The skin is to be removed from the prominence of the shoulder, by beginning in front at the anterior border of the deltoid muscle. Some small cutaneous nerves are to be found in the fat : some of these descend over the acromion, and others come to the surface about half way down the posterior border of the deltoid muscle.
- Cutaneous nerves of the shoulder. *Superficial nerves.*—Branches of nerves, *supra-acromial* (fig. 42¹), descend to the surface of the shoulder from the cervical plexus (p. 60). A *cutaneous branch* of the circumflex nerve turns forwards with a small companion artery from beneath the posterior border of the deltoid, and supplies the integument covering the lower two thirds of the muscle (Fig. 42, ²).
- Dissection of deltoid muscle. *Dissection.*—The fat and fascia are now to be taken from the deltoid muscle, its fibres being made tense at the same time. Beginning at the anterior edge of the muscle, the dissector is to carry the knife upwards and downwards in the direction of the fibres, in order that its coarse, oblique, muscular fasciculi may be more easily cleaned. At the same time the fascia may be removed from the back of the scapula, so as to denude the teres major and a part of the infraspinatus muscle.
- Deltoid muscle. The DELTOID MUSCLE is triangular in form, and has its base at the scapula and clavicle, and its apex at the humerus.
- Origin. It arises from nearly all the lower edge of the spine of the scapula, from the anterior or lower border of the acromion, and from the outer half or third of the clavicle. Its fibres
- Insertion. converge to a tendon, and are inserted by means of it into a triangular impression, above the middle of the outer surface of the humerus, which is two to three inches long, and about one inch wide above.
- Adjacent parts. The anterior border is contiguous to the pectoralis major muscle and the cephalic vein ; and the posterior rests on the infraspinatus and triceps muscles. The origin of the muscle corresponds with the attachment of the trapezius to the

bones of the shoulder; the insertion is united with the tendon of the pectoralis major, and has a fasciculus of the brachialis anticus on each side of it.

Dissection.—The deltoid is to be divided near its origin, and to be thrown down as much as the circumflex vessels and nerve will permit without cutting them. As the muscle is raised a large thick bursa between it and the head of the humerus comes into sight. The loose tissue and fat are to be taken away from the circumflex vessels and nerve, and the remains of the bursa are to be removed. The insertion of the muscle should be also examined.

Dissection
to detach
deltoid.

Parts covered by deltoid.—The deltoid conceals the head and the upper part of the humerus, and those parts of the dorsal scapular muscles that are fixed to its great tuberosity. Below the head of the bone are the circumflex vessels and nerve, and the upper part of the biceps muscle. In front of the humerus is the coracoid process with its muscles. A large bursa, sometimes divided into several sacs, intervenes between the convex head of the humerus and the under surface of the deltoid muscle and the acromion process.

Parts
covered by
the deltoid

Dissection.—By following back the circumflex vessels and nerve through a space between the humerus and the long head of the triceps, their origin from the axillary trunks will be arrived at. In clearing the fat from the space care must be taken of a branch of nerve to the teres minor muscle. Arching backwards in front of the neck of the humerus, is the small anterior circumflex artery.

Dissection
of circum-
flex vessels.

The *circumflex arteries* are the last branches of the axillary trunk, and arise near its termination (p. 269). They are two in number, and are named anterior and posterior from their position on the neck of the humerus.

Two circum-
flex arteries

a. The *anterior branch* is a small artery which courses transversely outwards, beneath the coraco-brachialis and biceps muscles, and anastomoses in front of the humerus with branches of the posterior circumflex. As it crosses the bicipital groove it sends upwards a branch to the articulation and the head of the humerus.

b. The *posterior circumflex artery* is larger in size, and arises opposite the border of the subscapular muscle. It winds backwards through a space between the humerus and the long head of the triceps, and is distributed chiefly to the deltoid muscle, in which it anastomoses with the acromial thoracic artery.

posterior.

Branches are given from it to the head of the humerus and the shoulder joint, and to anastomose with the anterior

its offsets.

circumflex artery. It supplies branches likewise to the teres minor, the long head of the triceps, and the integuments.

One circumflex nerve ;

The *circumflex nerve*, at its origin (p. 271), is placed beneath the axillary artery, and leaves the arm-pit by turning round the border of the subscapular muscle (fig. 44), with the artery of the same name. Behind the neck of the humerus the nerve divides into two parts, which supply the surrounding muscles, the integuments, and the shoulder joint. Before the circumflex nerve bifurcates it gives an *articular filament* to the under part of the shoulder joint.

articular branch ;
cutaneous,

a. One branch turns forwards beneath the deltoid nearly to the anterior border, and ends in the muscle, with the exception of one or two cutaneous filaments that pierce the fibres.

and muscular branches.

b. The other branch gives an offset to the teres minor muscle, which is remarkable in having a gangliiform swelling on it ; and it becomes cutaneous over the deltoid (fig. 42, ²) (p. 278), after supplying the posterior part of the muscle.

Infraspinatus muscle arises from fossa of that name ;

The *INFRASPINATUS MUSCLE* occupies the infraspinal part of the scapula, and extends to the head of the humerus. The muscle *arises* from the infraspinal fossa of the scapula, except near the neck, and except at the inferior border and lower angle of the bone where the teres muscles are attached ; it arises also from the lower side of the spinous process, and from the special fascia covering the surface. Its fibres converge to a tendon, which is *inserted* into the middle impression on the great tuberosity of the humerus, and joins with the tendons of the supraspinatus and teres minor muscles.

Insertion

is partly covered by deltoid.

A part of the muscle is subcutaneous, and the fibres arising from the spine of the scapula overlay the others and the tendon : the upper portion is concealed by the deltoid, and the lower end, by the latissimus dorsi. The lower border is parallel to the teres minor, with which it is sometimes united. The muscle lies on the scapula and the humero-scapular articulation, but between it and the joint is a small bursa. The subsequent dissection will show how far the muscle is separated from the bone, at the front of the infraspinal fossa, by the vessels and nerve, and the fat (p. 284).

Other connections.

Teres minor is on back of the scapula.

The *TERES MINOR* is a narrow fleshy slip, which is often united inseparably with the preceding muscle, along whose lower border it lies. It *arises* on the dorsum of the scapula from a special surface along the upper two thirds of the in-

ferior costa of the bone, and from the investing fascia ; and it is *inserted* by a tendon into the lowest of the three marks on the great tuberosity of the humerus, as well as by fleshy fibres into the humerus below that spot—about an inch altogether. This muscle is partly covered by the deltoid ; and it rests on the long head of the triceps and the shoulder joint. Underneath it the dorsal branch of the subscapular artery turns.

Insertion
with the
former.

Parts
around it.

The TERES MAJOR muscle is extended from the inferior angle of the scapula to the humerus. Its *origin* is from the rough surface on the dorsum of the scapula at the inferior angle ; from the inferior costa of the bone within an inch of the long head of the triceps ; and from the fascia covering the teres minor. The fibres end in a tendon which is *inserted* partly into, and partly behind the inner edge of the bicipital groove of the humerus.

Teres major
reaches from
lower angle
of scapula

to the humerus.

This muscle assists in forming the posterior fold of the axilla ; and is situate beneath the axillary vessels and nerves near the humerus. At its origin it is covered by the latissimus dorsi. The upper border is contiguous to the subscapularis muscle, and the lower is received into a hollow formed by the fibres of the latissimus dorsi. At the humerus the tendon of the muscle is one inch and a half to two inches wide, and is placed behind that of the latissimus : the two are separated above by an interval and a bursa ; but they are united below, and an expansion is sent from them to the fascia of the arm. A second bursa is beneath the tendon between it and the bone.

Adjacent
muscles.

Tendon and
bursa.

Below the scapula (inferior costa), where the teres muscles separate from one another, is a triangular interval, which is bounded in front by the shaft of the humerus, and above and below by the teres muscles. This space is divided into two by the long head of the triceps. Through the anterior part, which is of a quadrilateral shape, the posterior circumflex vessels and the circumflex nerve pass to the outer side of the limb ; and through the posterior smaller and triangular space, the dorsal branch of the subscapular artery turns to be distributed.

Two spaces
between the
teres and
head of the
triceps.

Anterior and
posterior.

Dissection.—In order that the acromion process may be sawn through to expose the supraspinatus muscle, the ligaments of the scapula and clavicle, which would be injured by such a proceeding, should be next dissected.

Dissection

These ligaments will be recognised by removing the fibrous tissue at the spots specified. One ligament (coracoclavicular) passes from the coracoid process to the under

of ligaments
of the clavi-
cle

part of the clavicle. A capsular ligament, connecting the outer end of the clavicle with the acromion, will be seen by taking away the fibres of the trapezius and deltoid muscles. Another strong band (coraco-acromial) passes transversely between the acromion and the coracoid process; and lastly a small fasciculus (posterior proper ligament) is placed over the notch in the superior costa.

Union of the clavicle and scapula.

LIGAMENTS OF THE CLAVICLE AND SCAPULA.—The clavicle is connected to the scapula by a distinct joint with the acromion, and by a strong ligament (coraco-clavicular) between it and the coracoid process.

Fig. 40.*



CLAVICULAR LIGAMENTS.—The *coraco-clavicular* ligament consists of two parts, each having a different direction and designation.

The posterior piece (fig. 40, ¹), called *conoid* from its shape, is fixed by its apex to the posterior and inner part of the coracoid process; and by its base to the tubercle and the contiguous part of the under surface of the clavicle, at the junction of the outer with the middle third of the bone.

* Ligaments of the clavicle and scapula and of the shoulder joint (altered from Bourgery and Jacob). 1. Conoid ligament. 2. Trapezoid ligament. 3. Anterior ligament of the scapula. 4. Posterior scapular ligament. 5. Capsule of the shoulder joint. 6. Tendon of the long head of the biceps entering the joint. 7. Tendon of the subscapularis muscle. 8. Coraco-humeral ligament.

The anterior part (fig. 40, ²), *trapezoid ligament*, is larger than the conoid piece: it is connected inferiorly to the inner border of the coracoid process along the hinder half, and superiorly to the line on the under surface of the clavicle which extends outwards from the tubercle before mentioned. The two parts of the ligament are united posteriorly, but are separated by an interval in front.

Acromio-clavicular articulation.—The articular surfaces of the clavicle and acromion process of the scapula are retained in contact by some scattered fibres, which form a kind of capsule for the joint. Some of the fibres are stronger above and below, and are considered to constitute a *superior* and an *inferior* ligament.

An *interarticular fibro-cartilage* is generally found between the bones only at the upper part of the joint; but sometimes it forms a complete interarticular septum. If the fibro-cartilage is perfect, there are two *synovial membranes*; if it is imperfect, there is only one present in the joint. The joint should be opened to see the cartilage and the synovial membrane.

SCAPULAR LIGAMENTS.—The *special ligaments* of the scapula are two in number, anterior and posterior, and extend from one to another part of the bone.

The *posterior* ligament (fig. 40, ⁴) is a round fasciculus of fibres stretching across the notch in the upper costa of the scapula. By one end it is attached to the base of the coracoid process, and by the other to the costa behind the notch. It converts the notch into a foramen, through which the suprascapular nerve passes.

The *anterior* ligament (fig. 40, ³) is triangular in form, and extends transversely between the acromion and the coracoid process (coraco acromial). Externally it is inserted by its point or apex into the tip of the acromion; and internally, where it is much wider, it is attached to all the outer border of the coracoid process, reaching backwards to the attachment of the capsule of the shoulder joint. This ligament overhangs the shoulder joint; it consists usually of two thickened bands, anterior and posterior, with a thin intervening part.

Dissection.—To lay bare the supraspinatus muscle, the acromion process is to be sawn through, and to be removed with the outer end of the clavicle. A strong fascia covers the surface of the muscle; this is to be taken away after it has been observed.

The SUPRASPINATUS MUSCLE has the same form as the Supraspina-

tus fills the hollow of that name;

is inserted into humerus.

Connections.

Dissection of suprascapular vessels.

Suprascapular artery

gives a suprascapular branch, and ends in infraspinatus.

Vein.

Suprascapular nerve has muscular branches like artery:

and articular.

Dorsal branch of subscapular artery.

hollow of the bone that it fills. It *arises* from the surface of the supraspinal fossa of the scapula, except from the cervical part; from the upper side of the spine of the bone; and from the fascia covering the surface. Its fibres end in a tendon, which crosses over the shoulder joint, and is *inserted* into the upper impression on the great tuberosity of the humerus. The muscle is concealed by the trapezius and the acromion process; and it rests upon the scapula, the shoulder joint, and the suprascapular vessels and nerve. Its tendon joins that of the infraspinatus at the attachment to the humerus.

Dissection.—The vessels and nerves on the dorsum of the scapula will be traced by separating from behind forwards the supra and infraspinatus muscles from the bone. In the supraspinal fossa are the suprascapular vessels and nerve, which are to be followed beneath the acromion to the infraspinal fossa; and entering the infraspinal fossa, beneath the teres minor muscle, is the dorsal branch of the subscapular artery. The anastomosis between the vessels should be carefully cleaned.

The *suprascapular artery* is derived from the subclavian trunk, and is one of the branches into which the thyroid axis subdivides (p. 74). After a short course in the neck it crosses over the ligament at the superior costa, and enters beneath the supraspinatus muscle. In that position it furnishes a *suprascapular* branch for the supply of the muscle, the bone, and the shoulder joint; and it ends in the infraspinal fossa, where it gives offsets to the infraspinatus muscle and the scapula, anastomosing with the dorsal branch of the subscapular, and with the posterior scapular artery of the subclavian (p. 74).

The companion *vein* of the suprascapular artery joins the external jugular vein.

The *suprascapular nerve* is a branch of the brachial plexus (p. 78). When it reaches the costa of the scapula, it enters the supraspinal fossa beneath the posterior special ligament. In the fossa it supplies two branches to the supraspinatus; and the nerve is continued finally beneath a fibrous band to the infraspinatus muscle, in which it ends.

The nerve gives some *articular* filaments to the shoulder joint, and other offsets to the scapula.

The *dorsal branch* of the *subscapular artery* (p. 269) turns backwards below the inferior costa of the scapula, through the posterior of the two spaces between the teres muscles. Entering the infraspinal fossa beneath the teres minor, it

supplies that muscle and the infraspinatus, and anastomoses with the ending of the suprascapular artery. This vessel sends a branch along the dorsum of the scapula between the teres muscles, towards the inferior angle of the bone, where it anastomoses with the posterior scapular artery.

SECTION III.

THE FRONT OF THE ARM.

Position.—For the dissection of the superficial vessels and nerves on the front of the arm the limb should lie flat on the table, with the front uppermost.

Dissection.—The skin is to be raised from the fore part of the arm and elbow joint. To allow of its reflection, make one incision along the centre of the limb as far as two inches below the elbow; and at the termination, a second cut half round the forearm. The skin should now be stripped from the front and back of the limb, as low as the transverse incision, so that the fat or superficial fascia which contains the cutaneous vessels and nerves may be denuded. Between the skin and the prominence of the olecranon a bursa may be seen.

The cutaneous veins (fig. 41) may be sought first in the fat. These vessels are very numerous below the bend of the elbow, and issue from beneath the integument. One in the centre of the forearm is the median vein, which bifurcates rather below the elbow. External to this is a small vein (radial); and internal to it are the anterior and posterior ulnar veins, coming from the front and back of the forearm. In the arm these veins are united into two; one (basilic) is to be followed along the inner border of the biceps, and the other (cephalic) along the outer side of the muscle.

The cutaneous nerves may be traced out next. On the outer side of the arm (fig. 43), about its middle, are the external cutaneous branches (two in number) of the musculospiral; and in the outer bicipital groove, in front of the elbow or rather below it, is the cutaneous part of the musculocutaneous nerve. On the inner part of the limb the nerves to the surface are more numerous. Taking the basilic vein as a guide, the internal cutaneous nerve of the forearm will be found by its side, about the middle of the arm; and rather external to this nerve is a small cuta-

and incisions in the skin.

Seek superficial veins.

Trace cutaneous nerves of outer side

and inner side of the limb.

neous offset from it, which pierces the fascia higher up. Behind the internal cutaneous in the lower third of the arm, is the small nerve of Wrisberg; and in the upper third at the same aspect, are the small nerves that have been already met with in the dissection of the axilla, viz., the intercosto-humeral, and the internal cutaneous of the musculo-spiral.

Superficial
fat.

The *superficial fascia* forms a continuous investment for the limb, but it is thicker in front of the elbow than in the other parts of the arm. In that spot it encloses the superficial vessels and lymphatics, and it may be divided into two layers.

The cutaneous veins
are

CUTANEOUS VEINS.—The position and the connections of the superficial veins in front of the elbow are to be attentively noted by the dissector, because the operation of venesection may be practised in them.

median
vein ;

1. The *median vein* of the forearm (fig. 41, ²) divides into two branches, internal and external, rather below the bend

of the elbow ; and at its point of division it is joined by an offset from a deep vein. The internal branch (median basilic) crosses to the inner border of the biceps, and unites with the ulnar veins (3) to form the basilic vein of the inner side of the arm. The external branch (median cephalic) is usually longer than the other, and by its junction with the radial vein (7) gives rise to the cephalic vein of the arm.

The connections of the two veins into which the median bifurcates, are described below,—

a. The *median cephalic vein* (fig. 41) is directed obliquely outwards, and lies over the hollow between the biceps and

the outer mass of muscles of the forearm. Beneath it is the trunk of the musculo-cutaneous nerve, and over it some

Fig. 41.*



divides
into two
branches.

Position and
connections
of median
cephalic,

* Cutaneous veins and nerves at the bend of the elbow. (From Quain's "Arteries.")—1. Median basilic vein. 2. Median vein of the forearm bifurcating. 3. Anterior ulnar veins. 4. Cephalic vein formed by radial from behind and the median cephalic in front. The musculo-

small offsets from that nerve are directed. This vein is altogether removed from the brachial artery, and is generally smaller than the median basilic vein. If opened with a lancet, it does not generally yield much blood, in consequence of its position in a hollow between muscles rendering compression of it very uncertain and difficult.

b. The *median basilic vein* (fig. 41, ¹) is usually more horizontal in direction than the preceding, and crosses the brachial artery as it tends to the inner side of the limb. It is larger than the corresponding vein of the outer side of the arm, and is firmly supported by the fascia beneath,—the aponeurosis of the arm, strengthened by fibres from the tendon of the biceps, intervening between it and the brachial vessels. Branches of the internal cutaneous nerve lie beneath it, and some twigs of the same nerve are placed over it.

and of the median basilic vein.

The median basilic is the vein on which the operation of bloodletting is commonly practised. It is selected in consequence of its usually larger size and more superficial position, and the ease with which it may be compressed; but from the close proximity of the vein to the brachial vessels, the spot chosen for the venesection should not be immediately over the trunk of the artery.

Venesection is practised in this branch.

2. The *basilic vein* (fig. 41, ²), commencing near the inner condyle of the humerus in the manner before said, ascends near the inner border of the biceps muscle to the middle of the arm, where it passes beneath the deep fascia, and is continuous with the axillary vein. In this course it lies over, or to the inner side of the brachial artery.

Basilic vein on inner side of the arm.

3. The *cephalic vein* (fig. 41, ³) is derived chiefly from the external branch of the median, for the radial vein is oftentimes very small. It is continued to the shoulder along the outer side of the biceps, and sinks between the deltoid and pectoral muscles, near the clavicle, to open into the axillary vein.

Cephalic vein at outer side of the arm.

The *superficial lymphatics* of the arm lie for the most part along the basilic vein, and enter into the glands of the axilla. A few lymphatics accompany the cephalic vein, and passing between the pectoral and deltoid muscles, end as the others in the axillary glands. A superficial lymphatic gland is

Superficial lymphatics.

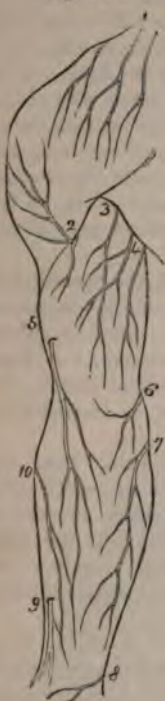
cutaneous nerve is by the side of it. 5. Basilic vein; with the large internal cutaneous nerve by its side. 6. Brachial artery, with its companion veins (one cut). 7. Radial vein.

commonly found as low in the limb as the elbow, where it lies in front of the inner condyle of the humerus.

The superficial nerves are derived from brachial plexus, except one.

CUTANEOUS NERVES.—The superficial nerves of the arm appear on the inner and outer sides, and spread so as to

Fig. 42.*



Two external cutaneous of musculo-spiral,

and one of musculo-cutaneous.

cover the surface of the limb. All with one exception (intercosto-humeral) are derived from the brachial plexus, either as distinct branches, or as offsets of other nerves. On the outer side of the limb are branches of the musculo-spiral and musculo-cutaneous nerves. On the inner side are two internal cutaneous nerves direct from the plexus (large and small), a third internal cutaneous from the musculo-spiral, together with the intercosto-humeral nerve.

EXTERNAL CUTANEOUS NERVES.—The external cutaneous branches of the musculo-spiral nerve are two in number, and appear at the outer side of the limb in the spot before mentioned. The upper one (fig. 43, ³) turns forwards with the cephalic vein, and reaches the front of the elbow, supplying the anterior part of the arm. The lower (fig. 42, ⁵) pierces the fascia somewhat farther down, viz., about the middle of the outer surface of the arm, and after supplying some cutaneous filaments to that part of the limb, is continued to the forearm.

The cutaneous part of the musculo-cutaneous nerve (fig. 41, ⁴) pierces the fascia in front of the elbow, and at the outer side of the tendon of the biceps muscle. It lies beneath the median cephalic vein, and divides into branches for the forearm.

Two internal cutaneous of brachial plexus.

INTERNAL CUTANEOUS NERVES.—The larger internal cutaneous nerve (fig. 43, ⁶) perforates the fascia in two parts, or as

* Cutaneous nerves of the back of the arm and forearm. (Quain's Anatomy.) 1. Supra acromial nerves of the cervical plexus. 2. Cutaneous branch of the circumflex nerve. 3. Internal cutaneous of the musculo-spiral trunk. 4. Intercosto-humeral nerve. 5. A lower external cutaneous of the musculo-spiral. 6. Nerve of Wrisberg. 7. Posterior branch of the internal cutaneous. 8. Dorsal branch of the ulnar nerve. 9. Radial nerve. 10. Posterior branch of the musculo-cutaneous.

one trunk that divides almost directly afterwards into two. Its external branch lies beneath the median basilic vein, and is directed to the front of the forearm; but the internal branch winds to the back of the forearm, over the prominence Large of the inner condyle of the humerus.

A *cutaneous* offset of this nerve pierces the fascia near the axilla (fig. 43, *), and reaches as far, or nearly as far as the elbow: it supplies the integuments over the inner part of the biceps muscle.

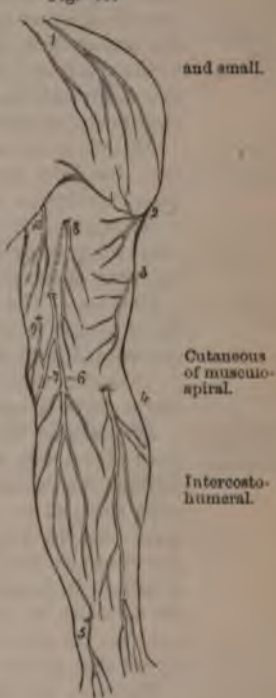
The *small internal cutaneous nerve* (Wrisberg), (fig. 43, *) appears below the preceding, and extends to the interval between the olecranon and the inner condyle of the humerus, where it ends in filaments over the back of the olecranon. The nerve gives offsets to the posterior surface of the lower third of the arm (fig. 42, *), and joins above the elbow the inner branch of the larger internal cutaneous nerve.

The *internal-cutaneous branch* of the musculo-spiral nerve, after it becomes subcutaneous (in the upper third), winds to the back of the arm (fig. 42, *), and extends nearly as far as the olecranon.

The *intercosto-humeral branch* of the second intercostal nerve (p. 259) perforates the fascia near the axilla (fig. 42, *), and furnishes filaments to the inner side and the posterior surface of the arm, in the upper half. But the size and even the distribution of the nerve will depend upon the development and extent of the small internal cutaneous, and of the offset of the musculo-spiral nerve.

The *aponeurosis* of the arm is a white shining membrane which surrounds the limb, and sends inwards processes between the muscles. Over the biceps muscle it is thinner

Fig. 43.*



* Cutaneous nerves of the front of the arm and forearm. (Quain's Anatomy.)—1. Supra acromial nerves. 2. Cutaneous of the circumflex. 3. Upper external cutaneous of the musculo-spiral. 4. Musculo-cutaneous nerve. 5. Cutaneous of the ulnar to the forearm. 6 and 7. Internal cutaneous, with an offset 8, to the arm. 9. Wrisberg's nerve. 10. Intercosto-humeral nerve.

than elsewhere. At certain points it receives accessory fibres from the subjacent tendons :—thus in front of the elbow there is an offset from the tendon of the biceps ; and near the axilla the tendons of the pectoralis major, latissimus dorsi, and teres, send prolongations to the fascia.

Disposition
above
and below :
forms inter-
muscular
septa.

At the upper part of the limb the fascia is continuous with that of the axilla, and is prolonged over the deltoid and pectoral muscles to the scapula and the clavicle. Inferiorly it is continued to the forearm, and is connected to the prominences of bone around the elbow joint, especially to the condyloid ridges of the humerus. Its attachments to the condyloid lines of the humerus give rise to the two intermuscular septa of the arm.

Directions
to be ob-
served.

Directions.—As the back of the arm will not be dissected first, the skin may be replaced on it until the front has been examined. And to keep in place the vessels and nerves at the upper part of the limb, they should be tied together with string, as near as it is possible to their natural position, and then fastened to the coracoid process.

Position of
limb.

Position.—The limb is still to lie on the back, but the upper part is to be raised by means of a small block beneath the scapula, and this bone is to be fixed in such a position as to render tense the muscles. The inner surface of the arm is to be placed towards the dissector.

Dissection
of muscles
and vessels.

Dissection.—The aponeurosis is to be reflected from the front of the arm by an incision along the centre, like that through the integuments ; and it is to be removed, on the outer side, as far as the line of the humerus leading to the outer condyle, but on the inner side rather farther back than the corresponding line, so as to lay bare part of the triceps muscle. In raising the fascia the knife must be carried in the direction of the fibres of the biceps muscle, and care must be taken not to displace the brachial artery and the nerves that are with it.

Position of
the muscles
of the arm.

MUSCLES ON THE FRONT OF THE ARM.—Only three muscles are present on the fore part of the arm. The most prominent one along the centre of the limb is the biceps ; and another along its inner side, reaching about halfway down, is the coraco-brachialis. The brachialis anticus muscle is beneath the biceps. Some muscles of the forearm are connected to the outer and inner condyles of the humerus, as well as to the line above the outer condyle.

Biceps has a
short and
long head.

The **BICEPS MUSCLE** (fig. 44, ^s) forms the prominence observable on the front of the arm. It is wider at the middle than at either end ; and the upper part of the muscle con-

sists of two tendinous pieces or heads of origin of different lengths, which are attached to the scapula. The short head *arises* from the apex of the coracoid process in common with the coraco-brachialis muscle; and the long head is attached to the upper part of the glenoid cavity of the scapula, within the capsule of the shoulder joint. Muscular fibres spring from each tendinous head, and blend about the middle of the arm in one fleshy mass, somewhat flattened from before back,—the belly of the muscle. Inferiorly the biceps ends in a tendon which is *inserted* into the tubercle of the radius.

Origin from the scapula.

Insertion into radius.

The muscle is superficial except at the extremities. At its upper part the biceps is concealed by the pectoralis major and deltoid muscles; and at the lower end the tendon dips into the hollow in front of the elbow, having previously given an offset to the fascia of the arm. Beneath the biceps are the brachialis anticus muscle, the musculo-cutaneous nerve, and the upper part of the humerus. Its inner border is the guide to the brachial artery below the middle of the humerus, but between it and the vessel above that spot the coraco-brachialis muscle intervenes. The connection of the long head of the biceps with the shoulder joint, and the insertion of the muscle into the radius, will be afterwards dissected.

Parts covering and beneath it.

Inner border is guide to the artery.

The CORACO-BRACHIALIS is a muscle of a roundish form, and is named from its bony attachments. Its *origin* is fleshy from the tip of the coracoid process, and from the tendinous short head of the biceps. Its fibres become tendinous below, and are *inserted*, below the level of the deltoid muscle, into a ridge on the inner side of the humerus, which separates the anterior and posterior surfaces: from its tendon of insertion an aponeurotic slip is continued upwards to the head of the humerus.

Coraco-brachialis is named from the attachments.

Part of the muscle is beneath the pectoralis major, and forms a prominence in the axilla; but the rest is superficial, except at the insertion where it is covered by the brachial vessels and the median nerve. The coraco-brachialis conceals the subscapular muscle, the anterior circumflex artery, and the tendons of the latissimus and teres. Along the inner border is the large artery of the limb with its nerves. Perforating it is the musculo-cutaneous nerve.

Connections of surrounding parts.

The BRACHIAL ARTERY (fig. 44, *) is a continuation of the axillary trunk, and supplies vessels to the upper limb. It begins at the lower border of the teres major muscle, and ends rather below the bend of the elbow, or

Brachial artery extends to elbow.

"opposite the neck of the radius," in two branches—radial and ulnar, for the forearm.

Fig. 44.*



Position to In the upper part of its course the vessel is internal to

* Axillary and brachial arteries and their branches. (From Quain's "Arteries.")—1. Axillary artery and branches: the small branch above the figure is the highest thoracic, and the larger branch close below, the

the humerus, but afterwards it is in front of that bone; and its situation is indicated on the surface by the depression along the inner border of the biceps and coraco-brachialis muscles.

bone, and situation in the limb.

In all its extent the brachial artery is very superficial; and it is covered mostly by the integuments and the deep fascia, except at the bend of the elbow where it becomes deeper, and is crossed in addition by the median basilic vein and the prolongation from the tendon of the biceps. Posteriorly the artery has the following muscular connections:—whilst it is inside the humerus it is placed successively over the long head of the triceps, and the inner head of the same muscle; but when the vessel has turned to the front of the bone, it lies on the insertion of the coraco-brachialis and on the brachialis anticus. To the outer side of the vessel are the coraco-brachialis and biceps muscles, the latter somewhat overlapping it in the lower part of the arm.

Connections with muscles and fascia.

Veins.—Vene comites lie on the sides of the artery, encircling it with branches, and the median basilic vein crosses over it at the elbow. The basilic vein is near the line of the artery, but superficial to the fascia in the lower half of the arm.

with veins.

The *nerves* in relation with the artery are the following:—The internal cutaneous is in contact with the vessel until it has perforated the fascia about the middle of the arm. The ulnar nerve lies to the inner side as far as the insertion of the coraco-brachialis muscle; and the musculo-spiral is behind the artery for a distance of about two inches. The median nerve is close to the vessel in all the course, but alters its position in this way:—as low as the insertion of the coraco-brachialis the nerve is on the outer side, but it then crosses obliquely either over or under the artery, and becomes internal to the vessel about two inches above the elbow joint.

and with nerves.

Branches spring both externally and internally from the brachial artery. Those on the outer side are *muscular*, and supply the coraco-brachialis, biceps, and brachialis anticus; those on the inner side are named superior and inferior profunda, anastomotie, and nutritious.

Its branches are

muscular,

1. The *superior profunda* branch (fig. 44, ^a) is larger than the others, and leaves the artery near the lower border of

superior profunda,

acromial thoracic. 2. Long thoracic branch. 3. Subscapular branch. 4. Brachial artery and branches. 5. Superior profunda branch. 6. Inferior profunda branch. 7. Anastomotie branch. 8. Biceps muscle. 9. Triceps muscle. The median and ulnar nerves are shown in the arm; the median is close to the brachial artery.

the tendon of the teres major ; it winds backwards with the musculo-spiral nerve to the triceps muscle, and will be dissected with the back of the arm.

inferior profunda,

2. The *inferior profunda* branch (fig. 44, ⁶) arises opposite the coraco-brachialis muscle, and accompanies the ulnar nerve to the interval between the olecranon and the inner condyle of the humerus. In the spot mentioned, it anastomoses with the posterior ulnar recurrent and anastomotic branches, and supplies the triceps. It arises often in common with the superior profunda artery.

nutrient of the bone,

3. A *nutritious* artery to the bone is given off near the preceding branch, and enters the large aperture about the middle of the humerus ; it is distributed to the osseous substance, and to the membrane lining the medullary canal.

and anastomotic.

4. The *anastomotic* branch (fig. 44, ⁷) arises from one to two inches above the elbow, and courses transversely inwards through the inter-muscular septum to the hollow between the olecranon and the inner condyle of the humerus. Here the artery inosculates with the inferior profunda and the posterior ulnar recurrent branch, and gives some branches to the triceps muscle : one of the muscular offsets forms an arch with a branch of the superior profunda across the back of the humerus, near the articulation of the elbow. The anastomotic branch likewise sends an offset in front of the elbow joint, which joins with the anterior ulnar recurrent, and supplies the pronator teres muscle.

Veins end in the axillary.

The BRACHIAL VEINS are placed along the artery, one on each side, and have branches of communication across that vessel ; they receive contributing veins, which correspond with the branches of the arteries. Superiorly they unite into one which joins the axillary vein near the subscapular muscle.

Deviations in position.

Peculiarities of the artery.—*The position.*—The brachial trunk may leave the inner border of the biceps in the lower half of the arm, and course along the inner intermuscular septum, with or without the median nerve,* to the inner condyle of the humerus. At this spot the vessel is directed to its ordinary position in front of the elbow, either through or beneath the fibres of the pronator teres, which has then a wide origin. In this unusual course the artery is often found to lie behind a projecting bony point of the humerus.

In place of division

The division.—Occasionally the artery is split for a short distance

* I have seen the nerve in this unusual position without its large companion artery, and accompanied by an offset from the superior profunda artery.

at its upper part, like the main vessel in the lower limb. And the terminal bifurcation of the vessel may be short of the ordinary spot, or beyond it:—the former condition is much the most frequent; for only in one instance did Mr. Quain find the vessel carried farther into the limb before it bifurcated, and in that example the point of division was “between two and three inches” beyond the elbow joint.

The origin of the arteries of the forearm.—The arteries of the forearm, viz. radial, ulnar, and interosseous, may be carried backwards, along the parent trunk, to any point between the axilla and the common origin at the elbow; but the unusual origin from the humeral trunk is most common in the upper third, and least frequent in the middle third of that vessel where a ligature may be applied. When one of the vessels referred to deviates thus from the ordinary condition, there would be two large arteries in the arm in the place of one. Commonly the two lie close together; though sometimes one of them, viz. the trunk that is to supply the front of the forearm and the palm of the hand, will lie close to the intermuscular septum, with the median nerve, like the trunk of the brachial artery.

In origin of usual arteries of forearm.

In some few cases the brachial artery has been observed to divide into three (radial, ulnar, and interosseous) at some little distance above the elbow, so that three trunks would be present in the lower part of the arm. In one body the three arteries of the forearm sprang from the end of the brachial below the elbow, in the same way as the three arteries of the leg come occasionally from the end of the popliteal trunk.

Unusual branching.

Aberrant branches.—Occasional long slender vessels, “*vasa aberrantia*,” connect the brachial or the axillary trunk with one of the arteries of the forearm or with a branch of these. The accessory vessels very rarely end in the ulnar artery.

In aberrant branches.

Muscular covering.—In some bodies the humeral artery is covered by an additional slip of origin of the biceps, or of the brachialis anticus muscle. And sometimes a slip of the brachialis may conceal, in cases of high origin of the radial, the remainder of the arterial trunk that continues to the forearm.

In muscular covering.

NERVES OF THE ARM.—The nerves on the front of the arm are derived from the terminal cords of the brachial plexus. Few of them furnish offsets to the arm, but they are continued, for the most part without branching, to the forearm and the hand. The cutaneous branches of some of them have been referred to (p. 288).

Nerves on front of arm.

The *median nerve* (fig. 44) arises from the brachial plexus by two roots, one from the outer, and the other from the inner cord (p. 270). Its destination is the palm of the hand, and it accompanies the brachial artery to the forearm. Commencing on the outer side of the artery, the nerve crosses over or under the vessel about the middle of the arm as before said (p. 293), and is found on the inner side a little above the elbow. It does not give any branch in the arm, but there may be a fasciculus connecting it with the

Median nerve in the arm is with the artery;

has not any branch in the arm.

musculo-cutaneous nerve. Its connections with muscles are the same as those of the artery.

Ulnar nerve
changes its
direction.

The *ulnar nerve* (fig. 44) is derived from the inner cord of the brachial plexus, and in its progress to the inner side of the hand, it courses along the inner part of the arm, and enters the forearm at the inner side of the elbow joint. At first the nerve lies close to the inner side of the axillary, and then on the same side of the brachial artery as far as the insertion of the coraco-brachialis: but leaving the blood-vessel in the remainder of the arm, it is directed inwards through the inner intermuscular septum, and descends to the interval between the olecranon and the inner condyle, being almost surrounded by the muscular fibres of the triceps. There is not any branch given from this nerve till it reaches the elbow joint, but a branch from the musculo-spiral to the triceps muscle accompanies it in the lower part of its course.

Is without
branch as
far as the
elbow.

Internal
cutaneous
nerve be-
neath the
fascia.

The *internal cutaneous* is a tegumentary nerve of the forearm, to which it is prolonged like the others. Part of the nerve has been before seen (fig. 43), and only that small portion which is beneath the fascia of the limb, remains to be studied in the arm. Arising from the inner cord of the plexus, it is at first internal, and then becomes superficial to the humeral artery as far as the middle of the arm, where it divides into two branches that perforate the investing fascia (6 and 7, p. 289). Near the axilla it furnishes a small cutaneous offset (8) to the integuments of the arm, which pierces the fascia higher than the trunk of the nerve.

Nerve of
Wrisberg

The *small internal cutaneous nerve* (nerve of Wrisberg*) is distributed in the part of the arm now dissected (fig. 43). It arises with the preceding. Concealed at first by the axillary vein, it is directed inwards either beneath or through the vein, and joins with the intercosto-humeral nerve. Afterwards it lies along the inner part of the arm as far as the middle, where it perforates the fascia to end in the integument (p. 289).

beneath the
fascia.

Musculo-
cutaneous
nerve in the
arm.

The *musculo-cutaneous nerve* (nerv. perforans, Casserii) is so named from supplying both the muscles and integument: it ends on the surface of the forearm, and supplies offsets to the flexors of the elbow joint whilst it is passing through the upper arm. It leaves the outer cord of the brachial plexus opposite the lower border of the pectoralis minor, and perforates directly the coraco-brachialis: it is

* An account of this nerve is given by Klint. See a Paper in Ludwig's *Scriptores Neurologici Minores*, tom. iii. "De Nervis Brachii."

then directed obliquely to the outer side of the limb between the biceps and brachialis anticus muscles. Near the elbow it has been seen to become a cutaneous nerve of the forearm (fig. 43, ⁴).

Branches.—The nerve furnishes branches to the muscles in front of the humerus, viz. to the coraco-brachialis as it passes through the fibres, and to the biceps and brachialis anticus muscles where it lies between them. Before perforating the coraco-brachialis the nerve gives usually a separate twig to that muscle and the short head of the biceps; and sometimes there is a large branch of communication with the median nerve after it has pierced the muscle. Its muscular branches.

Dissection.—The brachialis anticus muscle will be brought into view by cutting through the tendon of the biceps near the elbow, and turning upwards the muscle. The fascia and areolar tissue should be taken from the surface; and the lateral extent of the muscle should be defined, so as to show that the brachialis reaches the intermuscular septum largely on the inner side, but only for a short distance above, on the outer side. Dissection.

The BRACHIALIS ANTICUS covers the elbow joint, and the lower half of the front of the humerus. It arises from the anterior surface of the humerus below the insertion of the deltoid muscle; and from the intermuscular septa on the sides, though in very unequal proportions, viz. from all the inner, but from only the upper part of the outer one. The fleshy fibres converge to a tendon, which is inserted into the impression on the ulna before the coronoid process. Brachialis anticus.
Origin.
Insertion.

This muscle is concealed by the biceps. On it are the brachial artery, with the median, and musculo-cutaneous and musculo-spiral nerves. It lies on the humerus and the articulation of the elbow. Its origin embraces by two parts the attachment of the deltoid, and its insertion is placed between two corresponding fleshy pieces of the flexor profundus digitorum. The inner border touches the intermuscular septum in all its length; but the outer border is in contact with the external intermuscular septum only about one inch and a half above, and is separated from it lower down by two muscles of the forearm (supinator longus and extensor carpi radialis longior), which extend upwards on the humerus. The tendon of insertion will be seen in the dissection of the forearm. Connections.
Position over the elbow joint.

BACK OF THE ARM.

Position.—During the examination of the back of the Position of the part.

arm the limb is to be turned over, and raised into a semi-flexed position by means of a block of moderate thickness beneath the elbow. The scapula is to be drawn away till it is nearly in a line with the humerus, so as to tighten the muscular fibres; and it is then to be fastened with hooks in that position.

How to lay bare the triceps.

Dissection.—On the back of the arm there is only one muscle, the triceps (fig. 44, ⁹) with the musculo-spiral nerve and superior profunda artery beneath it. The muscle will be laid bare readily, for it is covered only by fascia—the skin having been reflected already, if the directions before given have been followed by the dissector. To take away the fascia, an incision is to be carried along the limb to a little below the elbow; and in reflecting it the subaponeurotic loose tissue should be removed at the same time.

Triceps muscle has three heads.

The TRICEPS MUSCLE is divided superiorly into three parts; and three heads of origin to it,—inner, outer, and middle, have been described. Two of these are attached to the humerus, and one to the scapula.

Origin of middle head,

The *middle* piece, or head, is the longest, and has a tendinous origin, about an inch wide, from the inferior costa of the scapula close to the glenoid cavity, where it is connected with the capsule of the shoulder joint. The *external* head reaches from the outer condyle of the humerus to the insertion of the teres minor muscle, and is attached to the posterior surface of the bone between the points mentioned, as well as to the intermuscular septum of the same side. The

of outer head,

and of inner head.

internal head reaches from the inner condyle to the upper border of the tendon of insertion of the teres major, and arises from the contiguous intermuscular septum, and the inner portion of the posterior surface of the humerus. From these processes of origin the fibres are directed to a common tendon of insertion at the lower part, with different degrees of inclination:—those of the middle head passing vertically, but those of the inner and outer heads obliquely downwards and inwards to the sides and the under part of the tendon.

Direction of the fibres.

Insertion.

The muscle is *inserted* inferiorly into the end of the olecranon process of the ulna, and gives an expansion to the aponeurosis of the forearm. Between the tip of the olecranon and the tendon is a small bursa.

Connections of the muscle.

The triceps is superficial, except at the upper part where it is overlapped by the deltoid muscle. It lies on the humerus, and conceals the musculo-spiral nerve, the superior profunda vessels, and the articulation of the elbow. On the sides the muscle is united to the intermuscular septa, and the lower

fibres of the outer head are continuous with the anconeus—one of the muscles of the forearm.

The *intermuscular septa* are processes of fibrous structure, continuous with the investing aponeurosis of the arm, which are fixed to the ridges leading to the condyles of the humerus: they intervene between the muscles on the front and back of the lower half of the arm, and give attachment to the fleshy fibres.

Two inter-muscular septa

attached to ridges of humerus.

The *internal* is the strongest, and reaches as high as the coraco-brachialis muscle, from which it receives some tendinous fibres. The brachialis anticus is attached to it in front, and the triceps behind; and the ulnar nerve and the inferior profunda and anastomotic arteries pierce it.

An inner and

The *external* septum is thinner, and ceases at the deltoid muscle. Behind it is the triceps; and in front of it are the brachialis anticus, and the muscles of the forearm arising above the condyle of the humerus (supinator longus and extensor carpi radialis longus): it is pierced by the musculo-spiral nerve.

outer.

Dissection.—To follow the superior profunda vessels and the musculo-spiral nerve, the middle head of the triceps should be cut across over them, and any fatty tissue that may obscure their position should be removed. To trace out the branches of the nerve and artery, which descend to the olecranon and the anconeus muscle, the triceps is to be divided in its whole length, and along the line of union of the outer with the middle head. The trunks of the profunda vessel and musculo-spiral nerve are to be afterwards followed beneath the outer head of the triceps to the front of the humerus.

Dissection of vessels and nerve.

The *superior profunda* branch of the brachial artery (p. 293) is the chief vessel for the supply of the triceps muscle. Accompanying the musculo-spiral nerve, it turns to the back of the humerus in the interval between the inner and outer heads of the triceps. In this position the artery supplies large muscular branches, and is continued onwards beneath the external head of the triceps to the outer part of the arm, where it divides into its terminal offsets:—One of these courses on the nerve to the front of the elbow joint, anastomosing with the recurrent radial artery: whilst others continue to the elbow along the intermuscular septum, and join the interosseous recurrent artery.

Superior profunda artery

lies behind the humerus.

Branches.—The muscular offsets of the vessel descend to the olecranon, supplying the triceps, and communicating with the other branches of the brachial artery, viz. inferior

Supplies triceps, and forms a circle around joint.

profunda and anastomotic (p. 294), as well as with the recurrent branches of the arteries of the forearm. One offset deserves especial notice; it accompanies a distinct branch of the musculo-spiral nerve, and ends in the anconeus muscle in the interval between the olecranon and the outer condyle of the humerus.

Musculo-spiral nerve winds behind humerus

to outer side of the arm.

Branches.

Internal cutaneous branch.

Branches to the triceps,

brachialis and muscles of forearm.

Two external cutaneous.

Subanconeal slip.

Attachments.

The *musculo-spiral nerve* arises from the posterior cord of the brachial plexus, of which it is the largest trunk, and is continued along the back and outer part of the limb to the hand. In the arm the nerve is placed first behind, and close to the axillary and brachial arteries; but it soon leaves the last vessel, and winds with the profunda artery beneath the triceps muscle from the inner to the outer part of the arm. At the outer aspect of the limb it is continued between the brachialis anticus and supinator longus muscles to the external condyle of the humerus, in front of which it divides into the radial and posterior interosseous nerves. In this extent the nerve gives muscular branches, and cutaneous offsets to both the inner and outer parts of the arm.

a. The *internal cutaneous branch* of the arm (fig. 42, ²) is of small size, and arises in the axillary space in common with the branch to the inner head of the triceps; it is directed across the posterior boundary of the axilla to the inner side of the arm, where it becomes cutaneous in the upper third, and is distributed as before said (p. 289).

b. The *muscular branches* to the triceps are numerous, and supply all the three heads. One slender offset, which is distributed to the inner head, arises in common with the preceding cutaneous branch, and lies close to the ulnar nerve till it enters the muscular fibres at the lower third of the arm. Another long and slender branch behind the humerus, appearing as if it ended in the triceps, can be followed downwards to the anconeus muscle. On the outer part of the limb the musculo-spiral nerve supplies the brachialis anticus, and two muscles of the forearm, viz. supinator longus and extensor carpi radialis longior.

c. The *external cutaneous branches* are two in number: they perforate the outer head of the triceps at its attachment to the humerus, and are distributed in the integument of the arm and forearm (p. 288).

Subanconeus muscle.—This is a thin fleshy stratum beneath the triceps near the elbow, which may be seen by cutting through that muscle at the lower part. It consists of two fasciculi, inner and outer: these are attached above the fossa for the olecranon, and end in the synovial sac of the joint.

A corresponding muscle is placed beneath the extensor of the knee joint.

Dissection.—As the dissection of the arm has been completed as far as the elbow, it will be advisable to examine next the shoulder joint. For this purpose the tendons of the surrounding muscles, viz. those of the subscapularis, supra and infraspinatus, and teres minor, must be detached from the joint. On the removal of loose fibrous tissue the articular capsule will be prepared.

Dissection
of the
shoulder
joint.

SHOULDER JOINT.—This joint (fig. 40) is formed between the head of the humerus and the glenoid fossa of the scapula. Inclosing the articular ends of the bones is a fibrous capsule lined by a synovial membrane. A ligamentous band (glenoid ligament) deepens the shallow scapular cavity for the reception of the large head of the humerus.

Shoulder
joint;
outline of.

This articulation has great extent of movement; and the bones entering into its formation are but slightly bound together by ligamentous bands, for, on the removal of the muscles, the head of the humerus may be drawn from the scapula with great readiness.

Looseness.

The *capsular ligament* (fig. 40, ^a) surrounds the articular ends of the bones, and receives some fibres from the contiguous tendons. At the upper part it is fixed around the neck of the scapula, where it is connected with the long head of the triceps. At the lower part the ligament is attached to the humerus close to the hemispherical articular surface; but its continuity is interrupted between the tuberosities of the bone by the tendon of the biceps muscle. On the inner side there is generally an aperture in the capsule, below the coracoid process, through which the synovial membrane of the joint is continuous with the bursa beneath the tendon of the subscapularis. The following muscles surround the articulation;—above are the tendons of the supraspinatus, infraspinatus, and teres minor; below the capsule is only partly covered by the subscapularis: and internally it is well supported by the last-named muscle.

Capsular
ligament.

Attach-
ments.

Muscles
around.

On the front of the capsule is a rather thick band of fibres,—the *coraco-humeral* or *accessory* ligament (fig. 40, ^b), which springs from the base of the coracoid process of the scapula, and ends in the great tuberosity of the humerus.

Accessory
band.

Dissection.—The articulation is to be opened by cutting circularly through the capsule near the scapula. When this has been done the attachment of the capsule to the

Dissection.

- bones, the glenoid ligament, and the tendon of the biceps will be manifest.
- Tendon of the biceps.** The *tendon of the biceps* muscle arches over the head of the humerus, and serves the purpose of a ligament in restraining the upward movements of that bone. It is attached to the upper part of the glenoid fossa of the scapula, and is connected on each side with the glenoid ligament. As it is directed outwards it becomes round; and entering the groove between the tuberosities of the humerus, it is covered by a prolongation from the tendon of the pectoralis major muscle, and is surrounded by the synovial membrane.
- Glenoid ligament.** The *glenoid ligament* is a firm fibrous band, which surrounds the fossa of the same name, deepening it for the reception of the head of the humerus. It is about two lines in depth, and is connected in part with the sides of the tendon of the biceps; but some of its fibres are fixed separately to the edge of the glenoid fossa.
- Synovial membrane.** The *synovial membrane* lines the articular surface of the capsule, and is continued beneath the subscapularis muscle through the aperture on the inner side. The membrane is further reflected around the tendon of the biceps, and lines the bicipital groove of the humerus.

SECTION IV.

THE FRONT OF THE FOREARM.

- Position of the limb.** *Position.*—The limb is to be placed with the palm of the hand uppermost; and the marking of the surface, and the projections of bone, are first to be noted.
- Surface of the forearm.** *Surface-marking.*—On the anterior aspect of the forearm are two lateral depressions, corresponding with the position of the main vessels. The external one is placed over the radial artery, and inclines towards the middle of the limb as it approaches the elbow. The internal one is evident only beyond the middle of the forearm, and points out the part of the ulnar artery that is uncovered by muscle.
- Bony projections.** The bones (radius and ulna) are sufficiently near the surface to be traced in their whole length: each ends below in a point,—the styloid process, and that of the radius is the lowest.
- Line of the wrist joint.** The articulation of the wrist is about an inch above the

transverse marking that separates the forearm from the hand.

On each side of the palm of the hand is a lateral projection; the external of these is formed by muscles of the thumb, and the internal by muscles of the little finger. Between the projections is the hollow of the palm, which is pointed towards the wrist. Two transverse lines are seen in the palm, but neither reaches completely across it; the anterior one will direct to the line of the articulations between the metacarpus and the phalanges, and is about a quarter of an inch behind the three inner joints when the fingers are extended.

The superficial palmar arch of arteries extends forwards a little way into the hollow of the hand, and its position may be marked by a line across the palm from the root of the thumb, when that digit is placed at a right angle to the hand.

Transverse lines are seen on both aspects of the joints of the thumb and fingers. The lines on the palmar surface of the fingers may be used to point out the articulations of the phalanges. Thus the joint between the metacarpal phalanx and the next will be found about a line in front of the chief of the transverse grooves near it; whilst the articulation between the last two phalanges is situate about a line in front of the single groove nearer the tip of the finger.

Dissection.—With the position of the limb still the same, an incision is to be carried through the skin along the middle of the front of the forearm, as far as an inch beyond the wrist; and at its termination a transverse one is to be united with it. The skin is to be reflected carefully from the front and back of the forearm, without injury to the numerous superficial vessels and nerves beneath; and it should be taken also from the back of the hand, by prolonging the ends of the transverse cut along the margins of the hand to a little beyond the knuckles. One finger should have the integument removed from it, in order that the nerves may be traced to the end.

The superficial vessels and nerves can be now traced in the fat. They have the following position:—In front of the forearm along the inner side are the ulnar veins, with the continuation of the internal cutaneous nerve; and near the wrist there is occasionally a small offset from the ulnar nerve. On the outer side are the radial vein, and the superficial part of the musculo-cutaneous nerve. Close to the

Surface of
palm of the
hand.

Palmar
arch.

Surface of
the fingers.

Lines on the
front.

Dissection
to remove
the skin.

Seek the
superficial
vessels and
nerves in
front.

hand, in the centre of the forearm, is the small palmar branch of the median nerve.

behind, At the back of the forearm the largest external cutaneous branch of the musculo-spiral nerve is to be traced ; and offsets are to be followed to this surface from the nerves in front.

and on the back of the hand. On the posterior part of the hand is an arch of superficial veins. The radial nerve, and a branch of the ulnar nerve, should be traced to the fingers,—the former along the outer, and the latter along the inner border of the hand.

Subcutaneous veins of the forearm are CUTANEOUS VEINS.—The superficial veins are named median, radial, and ulnar, from their position in the limb. They commence in the hand, chiefly at the dorsal aspect where they form an arch, and are continued along the forearm to end in the basilic and cephalic veins of the arm.

Arch on the hand ; *Superficial arch.*—This arch on the back of the hand is more or less perfect, and receives the posterior or superficial digital veins. At the sides the arch terminates in the radial and ulnar veins.

radial ; The *radial vein* begins in the outer part of the arch above mentioned, and in some small radicles from the back of the thumb. It is continued along the forearm, at first behind and then on the outer border, as far as the elbow, where it gives rise to the cephalic vein by its union with the outer branch of the median vein (fig. 41).

ulnar ; two sets, anterior The *ulnar veins* are anterior and posterior, and occupy the front and the back of the limb. The *anterior* arises near the wrist by the junction of small roots from the hand, and runs on the inner part of the forearm to the elbow ; here it unites with the inner branch of the median, and forms the basilic vein (fig. 41). The *posterior* ulnar vein is situate on the back of the limb. It commences on the hand by a large branch, “*vena salvatella*,” from the back of the little finger, uniting with the offset of the venous arch ; it is continued along the back of the forearm nearly to the elbow, and bends forwards to open into the anterior ulnar vein.

and posterior ; median. The *median vein* commences on the front of the arm, near the wrist, by small branches which are derived from the palmar surface of the hand ; and it is directed along the centre of the forearm nearly to the elbow. Here the vein divides into external and internal branches (median basilic and median cephalic), which unite, as before seen (fig. 41), with the radial and ulnar veins. At its point of bifurcation the

median receives a communicating branch from a vein accompanying the artery beneath the fascia.

CUTANEOUS NERVES.—The superficial nerves of the forearm are continued from those of the arm, viz. on the inner side from the large internal cutaneous nerve; and on the outer side from the two external cutaneous nerves derived from the musculo-spiral, and from the musculo-cutaneous. Occasionally there is a small offset of the ulnar nerve to the integument of the fore part of the limb. On the back of the hand is the termination of the radial nerve, together with a branch of the ulnar nerve.

The *internal cutaneous nerve* was seen in a previous dissection to be divided into two parts. The *anterior branch* (Fig. 43, ⁶) extends on the front of the forearm as far as the wrist, and supplies the integuments on the inner half of the anterior surface. Near the wrist it communicates sometimes with a cutaneous offset from the ulnar nerve. The *posterior branch* (Fig. 42, ⁷) continues along the back of the forearm (ulnar side) to rather below the middle.

The *cutaneous part* of the musculo-cutaneous nerve (Fig. 43, ⁴) is continued from the arm along the radial border of the limb to the ball of the thumb, on which it terminates in cutaneous offsets. Near the wrist the nerve is placed over the radial artery, and some twigs pierce the fascia to ramify on the vessel. A little above the middle of the forearm the nerve sends backwards a branch in the integuments of the posterior aspect nearly to the wrist, and communicates with the radial nerve as well as with the following cutaneous nerve.

The *external cutaneous branch* of the musculo-spiral nerve (Fig. 42, ¹⁰), after passing the elbow, turns to the hinder part of the forearm, and reaches as far as the wrist. Near its termination it joins the preceding cutaneous nerve.

The *radial nerve* ramifies in the integument of the back of the hand (Fig. 42, ⁹), and in that of the thumb and the next two fingers. It becomes cutaneous at the outer border of the forearm in the lower third, and after giving backwards some filaments to the posterior aspect of the limb, divides into two branches:—

a. One (external) is joined by the musculo-cutaneous nerve, and is distributed to the radial border and the ball of the thumb.

b. The other branch (internal) supplies the remaining side of the thumb, both sides of the next two digits, and half the

hand, in the centre of the forearm, is the small palmar branch of the median nerve.

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median.

transverse marking that separates the forearm from the hand.

On each side of the palm of the hand is a lateral projection; the external of these is formed by muscles of the thumb, and the internal by muscles of the little finger. Between the projections is the hollow of the palm, which is pointed towards the wrist. Two transverse lines are seen in the palm, but neither reaches completely across it; the anterior one will direct to the line of the articulations between the metacarpus and the phalanges, and is about a quarter of an inch behind the three inner joints when the fingers are extended.

The superficial palmar arch of arteries extends forwards a little way into the hollow of the hand, and its position may be marked by a line across the palm from the root of the thumb, when that digit is placed at a right angle to the hand.

Transverse lines are seen on both aspects of the joints of the thumb and fingers. The lines on the palmar surface of the fingers may be used to point out the articulations of the phalanges. Thus the joint between the metacarpal phalanx and the next will be found about a line in front of the chief of the transverse grooves near it; whilst the articulation between the last two phalanges is situate about a line in front of the single groove nearer the tip of the finger.

Dissection.—With the position of the limb still the same, an incision is to be carried through the skin along the middle of the front of the forearm, as far as an inch beyond the wrist; and at its termination a transverse one is to be united with it. The skin is to be reflected carefully from the front and back of the forearm, without injury to the numerous superficial vessels and nerves beneath; and it should be taken also from the back of the hand, by prolonging the ends of the transverse cut along the margins of the hand to a little beyond the knuckles. One finger should have the integument removed from it, in order that the nerves may be traced to the end.

The superficial vessels and nerves can be now traced in the fat. They have the following position:—In front of the forearm along the inner side are the ulnar veins, with the continuation of the internal cutaneous nerve; and near the wrist there is occasionally a small offset from the ulnar nerve. On the outer side are the radial vein, and the superficial part of the musculo-cutaneous nerve. Close to the

Surface of
palm of the
hand.

Palmar
arch.

Surface of
the fingers.

Lines on the
front.

Dissection
to remove
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arm, in order that the denuded parts may not become dry. Beginning with the dissection of the anterior surface of the limb,—let the student divide the aponeurosis along the front as far as the wrist, and take it away with the cutaneous vessels and nerves, except the small palmar cutaneous offsets of the median and ulnar nerves near the wrist. In cleaning the muscles it will be impossible to remove the aponeurosis from them at the upper part of the forearm without detaching the muscular fibres.

After the aponeurosis has been taken off, the termination of the brachial artery will be observed to lie with some fat in a hollow in front of the elbow, between two masses of muscles,—one arising from the inner, and the other from the outer condyle of the humerus. Two large arteries are in part laid bare; one (radial) lies along the radial border, the other (ulnar) is superficial only in the lower part of the forearm, and at the ulnar side. These vessels and their branches should be carefully cleaned. Vessels then seen.

The anterior annular ligament of the wrist, which arches over the tendons passing to the hand, is next to be defined. This structure is at some depth from the surface; and whilst the student attempts to make it apparent by removing the fibrous tissue superficial to it, he must take care of the small branches of the median and ulnar nerves to the palm of the hand. The ulnar artery and nerve pass over the ligament, and will serve as a guide to it. Define anterior annular ligament.

Hollow in front of the elbow (fig. 45).—The hollow in front of the elbow joint corresponds with the popliteal space at the knee, and is situate between the inner and the outer mass of the muscles of the forearm. This interval is somewhat triangular in shape, and the wider part is towards the humerus. It is bounded on the outer side by the supinator longus muscle, and on the inner side by the pronator teres. The aponeurosis of the limb is stretched over the space; and the bones covered by the brachialis anticus and supinator brevis muscles, form the deep boundary. Hollow in front of the elbow. Boundaries.

Contents.—In this hollow are lodged the termination of the brachial artery with its veins, and the median nerve; the musculo-spiral nerve; and the tendon of the biceps muscle, with some fat; these several parts have the following relative position in the space:—The tendon of the biceps is directed towards the outer boundary to reach the radius, into which it is inserted. Close to the outer side is the musculo-spiral nerve, which is partly concealed by the supinator longus muscle. Nearly in the centre of the space are Contents of the space and their position to one another.

- ring finger ; so that the radial nerve distributes the same number of digital branches to the dorsum as the median nerve furnishes to the palm of the hand. This division of the radial nerve communicates with the musculo-cutaneous and ulnar nerves ; and the offset to the contiguous sides of the ring and middle fingers is joined by a twig from the dorsal branch of the ulnar nerve.
- which supply the fingers. **Termination.** On the sides of the fingers each of these dorsal digital nerves is united with an offset from the digital nerve on the palmar surface, and extends to the tip of the digit.
- Branch of ulnar nerve to back of hand and fingers. The *dorsal branch of the ulnar nerve* (Fig. 42, *) furnishes offsets to the rest of the fingers and the back of the hand. Appearing by the styloid process of the ulna, it joins in an arch across the back of the hand with the radial nerve, and is distributed to both sides of the little finger, and to the ulnar side of the ring finger : moreover it communicates with the part of the radial nerve that supplies the space between the ring and middle fingers. The ulnar nerve supplies branches to the same number of digits on the palmar surface.
- Deep fascia of the forearm. The *aponeurosis* of the forearm is continuous with a similar investment of the arm. It is of a pearly white colour, and is formed of fibres that cross obliquely : it furnishes also the muscles with sheaths, and is thicker behind than before. Near the elbow it is stronger than towards the hand ; and at that part it receives fibres from the tendon of the biceps and the brachialis anticus, and gives origin to the muscles attached to the inner condyle of the humerus. On the back of the limb the aponeurosis is connected to the margins of the ulna, so as to leave the upper part of the bone sub-cutaneous ; and it receives some fibres from the tendon of the triceps. Horizontal processes are sent downwards from the aponeurosis to separate the superficial and deep layers of muscles, both on the front and back of the forearm ; and longitudinal white bands indicate the position of the different intermuscular processes, which isolate one muscle from another, and give origin to the muscular fibres.
- In front. At the wrist the fascia joins the anterior annular ligament ; and near this band the tendon of the palmaris longus pierces the fascia, and receives a sheath from it. Behind the wrist it is thickened by transverse fibres, and gives rise to the posterior annular ligament ; but on the back of the hand and fingers the fascia becomes very thin.
- On the back of the limb. *Dissection.*—The skin is to be replaced on the back of the forearm and hand, in the same manner as on the back of the
- Intermuscular pieces. annular ligament.
- At the wrist ; Take away fascia, nerves, and veins.

arm, in order that the denuded parts may not become dry. Beginning with the dissection of the anterior surface of the limb,—let the student divide the aponeurosis along the front as far as the wrist, and take it away with the cutaneous vessels and nerves, except the small palmar cutaneous offsets of the median and ulnar nerves near the wrist. In cleaning the muscles it will be impossible to remove the aponeurosis from them at the upper part of the forearm without detaching the muscular fibres.

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Contents of the space
and their position to one another.

the brachial vessels and the median nerve, the nerve being internal ; but as the artery is inclining to the outer part of the limb, they soon become distant from one another about half an inch. In this space the brachial artery divides into two trunks—radial and ulnar.

Superficial
layer has
five muscles.

MUSCLES ON THE FRONT OF THE FOREARM (fig. 45).—

The muscles on the front of the forearm are divided into a superficial and a deep layer. In the superficial layer there are five muscles, which are fixed to the inner condyle of the humerus, mostly by a common tendon, and lie in the under-mentioned order from the middle to the inner side of the limb ; viz. pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, which are on the same level ; and deeper and larger than any of these is the flexor sublimis digitorum. The deep layer will be met with in a future dissection.

Pronator
teres.

Origin.

Insertion.

Con-
nections.

The PRONATOR RADII TERES (fig. 45, ³) arises from the inner condyle of the humerus by the common tendon, and from the ridge above the condyle by fleshy fibres ; from the inner part of the coronoid process by a second tendinous slip ; and from the fascia and the intermuscular septum between it and the next muscle. It is *inserted* by a rather flat tendon into an impression, an inch in length, on the outer surface of the middle of the radius.

The muscle is superficial except at the insertion, where it is covered by the radial artery, and one of the outer set of muscles (supinator longus). The pronator forms the inner boundary of the triangular space in front of the elbow ; and its inner border is contiguous to the flexor carpi radialis. By gently separating the muscle from the rest, it will be found to lie on the brachialis anticus, on the flexor sublimis digitorum, and on the ulnar artery and the median nerve. The second small head of origin is directed inwards between the artery and the nerve.

Radial
flexor of the
wrist.

The FLEXOR CARPI RADIALIS (fig. 45, ⁴) takes its origin from the common tendon, from the aponeurosis of the limb, and from the intermuscular septum on each side. The tendon of the muscle, becoming free from fleshy fibres about the middle of the forearm, passes through a groove in the os trapezium, outside the arch of the anterior annular ligament, and is *inserted* into the base of the metacarpal bones of the index and middle fingers.

The muscle
is super-
ficial ;

This muscle rests chiefly on the flexor sublimis digitorum ; but near the origin it is in contact with the ulnar artery and the median nerve, and near the wrist it lies over the flexor

longus pollicis,—a muscle of the deep layer. As low as the middle of the forearm the muscle corresponds externally with the pronator teres, and below that point with the radial artery to which its tendon is taken as the guide. The ulnar border is at first in contact with the palmaris longus muscle, and then with the median nerve about two inches above the wrist.*

The PALMARIS LONGUS (fig. 45, ⁵) is often absent: or it may present great irregularity in the proportion between the fleshy and tendinous parts. Its *origin* is connected, like that of the preceding muscle, with the common tendon, the fascia, and the intermuscular septa. Its long thin tendon is continued along the centre of the forearm, and over the annular ligament, to end in the palmar fascia, but it gives a tendinous slip to join the short muscles of the thumb. The palmaris is situate between the flexor radialis and flexor carpi ulnaris muscles, and rests on the flexor sublimis digitorum.

The FLEXOR CARPI ULNARIS (Fig. 45, ⁷) has an aponeurotic attachment to the inner condyle of the humerus; to the inner side of the olecranon; and to the ridge of the ulna between the internal and posterior surfaces, for three fourths of its length. Most of the fibres are continued vertically downwards, but others obliquely forwards to a tendon on the anterior part of the muscle in the lower half, some joining it as low as the wrist; and the tendon is *inserted* into the pisiform bone, while an offset is sent to the annular ligament and the muscles of the little finger.

One surface of the muscle is in contact with the fascia; Adjacent parts.

* In the dissection of the body of a woman which was well developed, the muscle was found to be absent on both sides.

† Superficial view of the forearm (from Quain's Arteries). 1. Ra-

Fig. 45,†



and its tendon may be taken as the guide to the ulnar artery, since it can be felt readily through the skin. To its radial side at first are the palmaris and flexor digitorum sublimis muscles, but below the middle of the forearm the ulnar artery and nerve are placed along it. When the attachment to the inner condyle has been divided, and the parts cleaned underneath, the muscle will be seen to conceal the flexor digitorum sublimis and flexor profundus, the ulnar nerve, and the ulnar vessels in part. Between the attachments to the condyle and the olecranon the ulnar nerve enters the forearm.

Course and
extent of
the radial
artery.

The RADIAL ARTERY (fig. 45, ¹) is one of the vessels derived from the bifurcation of the brachial trunk, and its destination is the palm of the hand. It is placed first along the outer side of the forearm as far as the end of the radius; it winds backwards next below the extremity of the bone; and it enters finally the palm of the hand through the first interosseous space. In consequence of this circuitous course the artery will be found in three different regions; viz. the front of the forearm, the back of the wrist, and the palm of the hand.

Situation in
the forearm.

In the front of the forearm.—In this part of the limb the position of the artery will be marked, on the surface, by a line from the centre of the hollow of the elbow to the fore part of the styloid process of the radius. This vessel is smaller than the ulnar artery, though it appears in direction to be the continuation of the brachial trunk.

Connections
with parts
over it,

In all its extent the radial artery is quite superficial, being covered mostly by the common tegumentary investments and the deep fascia, and during life it can be felt beating as the pulse near the wrist. Its connections with the surrounding muscles and the radius are these:—In the upper half of the forearm the vessel is placed between the supinator longus externally and the pronator teres internally, the former overlapping it; but in the lower half it lies between the tendons of the supinator longus and flexor carpi radialis.

on the
sides,

behind, and
with the
radius.

At first the artery is on the inner side of the radius, but afterwards over that bone. It is placed successively over the following parts, viz. the fleshy supinator brevis, the tendon of the pronator teres, the thin radial origin of the flexor sublimis, and on two other muscles of the deep layer,

dial artery with its nerve outside. 2. Ulnar artery and nerve where they are superficial. 3. Pronator teres. 4. Flexor carpi radialis. 5. Palmaris longus. 6. Flexor sublimis. 7. Flexor carpi ulnaris. 8. Supinator longus. 9. Biceps. 10. Palmaris brevis. 11. Palmar arch of the ulnar artery.

viz. flexor pollicis longus and pronator quadratus, and lastly on the end of the radius.

The usual venæ comites are found on the sides of the artery. The radial nerve is on the outer side of, though not in contact with the vessel, in the upper two thirds of the forearm, or until it passes backwards beneath the tendon of the supinator longus and becomes cutaneous.

Branches.—The radial artery furnishes many unnamed muscular and nutrient branches to the surrounding parts; and three named branches, viz. recurrent radial, superficial volar, and anterior carpal.

1. The *radial recurrent* is the first branch of the artery, and supplies the muscles of the outer side of the limb. Its course is almost transverse to the supinator longus muscle, beneath which it terminates in muscular ramifications. One offset ascends beneath the supinator, and anastomoses with the superior profunda branch of the brachial artery.

2. The *superficial volar* branch arises usually near the lower end of the radius, but its exact place of origin is uncertain. It is directed towards the palm of the hand, across or through the mass of muscles in the ball of the thumb, and it either ends in those muscles, or joins the superficial palmar arch.

3 The *anterior carpal* branch is very inconsiderable in size, and will be seen in the examination of the deep layer of muscles. Arising rather above the lower end of the radius, it passes transversely beneath the muscles, and anastomoses with a similar branch from the ulnar artery: from the arch thus formed at the lower border of the pronator quadratus muscle, offsets are given to the carpus.

Peculiarities of the radial artery.—The origin of the radial artery may be carried upwards in the arm from the usual place even to the axilla. This vessel arises from the humeral much more frequently than the other arteries of the forearm, viz. in the proportion in a given number of cases of about three to four. In one instance (Quain), it was noticed between two and three inches below the elbow joint, and in that case a vas aberrans connected it with the axillary artery.

When the radial artery has a high origin, its course in the arm is close to the brachial artery, along the edge of the biceps muscle; and in passing the bend of the elbow it may be occasionally subcutaneous, viz. above the deep fascia, and be liable to injury in venesection. In the forearm it may be likewise subcutaneous, and superficial to the supinator longus muscle.

The *aberrant arteries*, "vasa aberrantia," or the long slender branches of the axillary or brachial trunk open commonly into the radial artery. In some cases of high origin of the radial, there

is a connecting branch at the bend of the elbow between it and the trunk in the place of the brachial artery.

Dissection. *Dissection.*—To bring into view the remaining muscle of the superficial layer (flexor sublimis digitorum), the origin of the flexor carpi radialis and palmaris longus must be cut through near the inner condyle of the humerus, and turned to one side. Small branches of the ulnar artery and median nerve may be seen to enter the under surface of those muscles. For the present the pronator teres may be left uncut.

Superficial flexor of fingers. The FLEXOR DIGITORUM SUBLIMIS vel PERFORATUS (fig. 45,⁶) is the largest of the muscles of the superficial layer, and is named from its position to another flexor in the deep layer.

Origin. It arises from the inner condyle of the humerus, from the internal lateral ligament, and from the intermuscular septa in common with the preceding muscles; and it takes origin in addition from the bones of the forearm, viz. from the inner part of the coronoid process of the ulna; from the oblique line extending from the tubercle of the radius, and from the anterior border of the bone as far as two inches below the insertion of the pronator teres.* Rather below the middle of the forearm the muscle ends in four tendons, which are continued beneath the annular ligament and across the hand, to be inserted into the middle phalanges of the fingers, after being perforated by the tendons of the deep flexor.

Insertion.

Connections with parts around. The flexor sublimis is concealed above by the other muscles of the superficial layer; and the radial vessels lie on the attachment to the radius. Along the inner border is the flexor carpi ulnaris, with the ulnar vessels and nerve. The tendons of the muscle are arranged in pairs before they pass beneath the annular ligament of the wrist; the middle and ring finger tendons being anterior, and those of the index and little finger posterior in position. When the coronoid and condyloid attachments are divided, the muscle will be seen to cover two flexors of the deep layer (flexor digitorum profundus and flexor pollicis), the median nerve, and the upper part of the ulnar artery.

Ulnar artery ends in palm of hand. The ULNAR ARTERY (fig. 45,⁵), is the larger of the two branches coming from the bifurcation of the brachial trunk, and is directed along the inner side of the limb to the palm of the hand. At its extremity it forms the superficial palmar arch, and joins the radial artery.

* Oftentimes this origin does not extend lower than the attachment of the pronator muscle.

In the forearm the vessel has an arched direction, and its depth from the surface varies in the first and last parts of its course. In the upper half of the forearm the artery is inclined obliquely inwards, between the superficial and deep layers of muscles, and is covered by the former, viz. by the pronator teres, flexor carpi radialis, palmaris longus, and flexor sublimis. But below the spot mentioned, the vessel is superficial between the tendons of the flexor sublimis and flexor carpi ulnaris, and is concealed by the common integuments and the proper fascia of the limb, though the flexor ulnaris overlays it and serves as the guide to its position. Beneath the artery will be found first the brachialis anticus for a short distance, and afterwards the flexor profundus.

Connections
in the upper

and lower
half of the
forearm.

The two companion veins are situate on the sides of the artery. The median nerve lies to the inner side of the vessel for about an inch, but then crosses over it to gain the outer side. About the middle of the forearm the ulnar nerve approaches the artery, and continues thence on the inner side. A small branch of the ulnar nerve descends on the lower part of the vessel to the palm of the hand.

Position of
veins and
nerves.

On the annular ligament of the wrist the artery lies close to the pisiform bone, and is crossed by a band of fibres prolonged from the tendon of the flexor carpi ulnaris to the ligament. The ulnar nerve still accompanies the vessel, having the same position, viz. on the inner side.

Position on
the annular
ligament.

Branches.—The greater number of the collateral branches of the artery are distributed to the muscles. But the named branches are the following :—

its branches
besides mus-
cular are

1. The *anterior ulnar recurrent* branch arises generally in common with the next, and ascends on the brachialis anticus muscle to inosculate with the small anastomotic artery beneath the pronator radii teres. It gives offsets to the contiguous muscles.

anterior and

2. The *posterior ulnar recurrent* branch, of larger size than the anterior, is directed inwards beneath the flexor sublimis muscle to the interval between the inner condyle and the olecranon. Here it passes with the ulnar nerve between the attachments of the flexor carpi ulnaris, and joins the ramifications of the inferior profunda and anastomotic arteries on the inner side of the elbow joint. Some of its offsets enter the muscles, and others supply the articulation and the ulnar nerve.

posterior
recurrent,

3. The *interosseous* branch is a short, thick trunk, about an inch long, which is directed backwards towards the

interos-
seous,

interosseous membrane, and divides into anterior and posterior interosseous arteries: these branches will be afterwards followed.

metacarpal, 4. The *metacarpal* branch arises from the artery near the lower end of the ulna, and turns back along the metacarpal bone of the little finger, of which it forms a dorsal branch.

and carpal. 5. The *carpal* branches (anterior and posterior) ramify on the front and back of the carpus, on which they anastomose with corresponding offsets of the radial artery, and form arches across the wrist.

The origin *Peculiarities of the ulnar artery.*—The *origin* of the ulnar artery has a tendency to approach the trunk of the body, and it may be transferred to any point of the vessel in the arm or axilla; but this deviation is much less frequent in it than in the radial artery. Once the origin was found between two and three inches below the elbow. (Quain.)

and course of the artery may vary. Its irregular *position* in the forearm varies more than that of the radial under similar circumstances. The artery is generally superficial to the flexor muscles at the bend of the elbow (only one exception, Mr. Quain), but beneath the aponeurosis of the forearm, though sometimes it is subcutaneous with the superficial veins.

Ulnar nerve in the forearm. The ULNAR NERVE enters the forearm between the attachments of the flexor carpi ulnaris to the olecranon and inner condyle of the humerus. Under cover of that muscle the nerve reaches the ulnar artery about the middle (in length) of the forearm, and is continued on the inner side of the vessel to the hand. On the annular ligament the nerve is rather posterior to the artery. In this part of the limb it furnishes articular, muscular, and cutaneous branches as below:—

to elbow joint, *a. Articular nerves.*—In the interval between the olecranon and the inner condyle, the ulnar nerve gives slender filaments to the articulation against which it lies.

to two muscles of forearm, *b. Muscular branches.*—It furnishes offsets near the elbow joint to two muscles of the forearm, viz. flexor carpi ulnaris and flexor profundus. One branch enters the upper part of the flexor carpi ulnaris, and the other supplies the inner half of the flexor profundus digitorum.

cutaneous branch of palm of hand, *c. Cutaneous nerve of the forearm and hand.*—About the middle of the forearm a small cutaneous branch (palmar) arises from the nerve, and continues on the ulnar artery, sending twigs around it, to end in the integuments of the palm of the hand. Sometimes a cutaneous offset from it perforates the aponeurosis near the wrist, and joins the internal cutaneous nerve.

cutaneous *d. The dorsal cutaneous nerve of the hand* arises about two

inches above the end of the ulna, and passes obliquely backwards beneath the flexor carpi ulnaris muscle: it finally perforates the aponeurosis of the limb, and is lost on the back of the hand and fingers (p. 306).

nerve of
back of
hand.

The MEDIAN NERVE leaves the hollow of the elbow between the heads of origin of the pronator teres, and takes the middle line of the limb in its course to the hand. It is placed beneath the flexor sublimis as low as two inches from the annular ligament, but it then becomes superficial along the outer border of the tendons of that muscle. Lastly the nerve dips beneath the annular ligament to enter the palm of the hand, where it is distributed. This nerve supplies the muscles on the front of the forearm, and furnishes cutaneous offsets only to the hand.

Median
nerve

lies between
the two
layers of
muscles.

a. *Muscular offsets* leave the trunk of the nerve near the elbow, and are distributed to all the muscles of the superficial layer except the flexor carpi ulnaris; in addition, the nerve supplies the deep layer through the following branch (interosseous), except the inner half of the flexor profundus digitorum.

Supplies the
front mus-
cles, except
one and a
half.

b. The *anterior interosseous nerve*.—By means of this nerve the remaining muscles of the deep layer are supplied, with the exception above specified. It accompanies the anterior interosseous artery, and will be dissected with that vessel.

Interos-
seous
branch.

c. The *cutaneous palmar branch* arises at the lower part of the forearm; it pierces the fascia near the annular ligament, and crosses the ligament to reach the palm of the hand.

A cutaneous
branch to
palm of
hand.

The RADIAL NERVE is the larger of the two branches into which the musculo-spiral divides in front of the outer condyle of the humerus. This nerve is placed along the outer border of the limb, under cover of the supinator longus, and on the outer side of the radial artery till within three inches of the wrist, where it becomes cutaneous at the posterior border of the tendon of the supinator. On the surface of the limb it divides into two branches, which are distributed on the dorsum of the hand, and on the thumb and the next two fingers (p. 305). No offset is furnished by the part of the nerve beneath the aponeurosis.

Radial nerve
in

the forearm.

ends on
back of the
hand.

Dissection.—To examine the deep layer of muscles it will be necessary to draw well over to the radial side of the forearm the pronator teres and flexor sublimis muscles; or if it is thought necessary, these muscles may be divided. The areolar tissue is to be taken from the muscular fibres; and the anterior interosseous vessels and nerve, which lie on the

Dissection
of deep
layer of
muscles.

interosseous membrane and are concealed by the muscles, are to be traced out.

Three muscles in the deep layer.

DEEP LAYER OF MUSCLES.—Only three muscles are present in the deep layer on the front of the forearm. One lies on the ulna, and is the deep flexor of the fingers; another covers the radius, viz. the long flexor of the thumb; and the third is the pronator quadratus, which is beneath the other two near the lower end of the bones.

Deep flexor of fingers,

Origin.

Is attached to last phalanges.

Parts around it.

The **FLEXOR DIGITORUM PROFUNDUS** vel **PERFORANS** arises from the anterior and inner surfaces of the ulna for three fourths of the length of the bone; from the inner half of the interosseous ligament for the same distance; and from an aponeurosis common to this muscle and the flexor carpi ulnaris. The muscle has a thick fleshy belly, and ends in four tendons, which pass beneath the annular ligament, being still united together, and are inserted into the last phalanges of the fingers.

The cutaneous surface of the muscle is in contact with the ulnar nerve and vessels, with the superficial flexor of the fingers, and with the flexor carpi ulnaris. The deep surface rests on the ulna and the pronator quadratus muscle. The outer border touches the flexor pollicis longus and the anterior interosseous vessels and nerve; and the inner is connected by the aponeurosis to the posterior margin of the ulna.

Long flexor of thumb.

Origin.

Insertion.

Parts above and beneath it.

Pronator quadratus is on lower end of bones of forearm;

is deep in position.

The **FLEXOR LONGUS POLLICIS** arises from the upper two thirds of the hollowed anterior surface of the radius, as low as the pronator quadratus; from the outer part of the interosseous membrane; and by a round distinct slip from the coronoid process of the ulna, internal to the attachment of the brachialis anticus. The fleshy fibres descend to a tendon, which is continued beneath the annular ligament, and is inserted into the last phalanx of the thumb. On the cutaneous surface of the muscle is the flexor sublimis, together with the radial vessels for a short distance inferiorly. The muscle lies on the radius and the pronator quadratus. To the inner side is the flexor profundus digitorum.

The **PRONATOR QUADRATUS** is a flat muscle, and lies on the lower fourth of the bones of the forearm. The muscle arises from the anterior and inner surfaces of the ulna, where it is somewhat the widest, and is inserted into the fore part of the radius for about two inches. The anterior surface is covered by the tendons of the flexor muscles of the fingers, and by the radial artery; and the posterior surface rests on the radius and ulna with the intervening membrane, and on the interosseous vessels and nerve.

The *anterior interosseous artery* (p. 313) is continued on the front of the interosseous membrane, between or in the fibres of the deep flexor muscles, till it reaches the aperture below the membrane. At that spot the artery turns from the front to the back of the limb, and descends to the posterior surface of the carpus, where it ends by anastomosing with the posterior interosseous and carpal arteries.

Branches.—Numerous offsets are given to the contiguous muscles. Anterior interosseous artery.
Muscular branches.

One long branch, *median*, accompanies the median nerve, supplying it, and either ends in the flexor sublimis, or extends beneath the annular ligament to the hand. Median :

About the middle of the forearm two nutrient vessels of the bones arise from the artery. nutrient to the bones

Where it is about to turn backwards, it furnishes twigs to the pronator quadratus, and one branch is continued beneath the muscle to anastomose with the anterior carpal arteries. and the carpus.

The *anterior interosseous nerve* is derived from the median (p. 315), and accompanies the artery of the same name to the pronator quadratus muscle, on the under surface of which it ends. Some lateral branches are distributed by it to the deep flexor muscles. Anterior interosseous nerve ends in pronator.

SECTION V.

THE PALM OF THE HAND.

Dissection.—Without any change in the position of the hand, the skin is to be reflected from the palm by means of two incisions. One is to be carried along the centre of the hand from the wrist to the fingers; and the other is to be made from side to side, at the termination of the first. In raising the inner flap, the small palmaris brevis muscle will be recognised at the inner margin of the hand, near the wrist. In the fat the ramifications of the small branches (palmar) of the median and ulnar nerves are to be sought. Dissection.
Seek the cutaneous nerves.

The student should remove the fat from the palmaris muscle, and from the strong palmar fascia in the centre of the hand; and he should be careful not to destroy a thin transverse band of tissue (transverse ligament), which lies across the roots of the fingers. When cleaning the fat from the palmar fascia he will recognise the digital vessels and Define the palmar fascia.

- and expose digital sheaths. nerves, and must be especially careful of two,—viz., those of the inner side of the little finger and outer side of the index finger, which appear farther back than the rest, and are most likely to be injured.
- Some unnamed. Lastly, the skin and the fat may be reflected from the thumb and the fingers by an incision along each, so that the sheaths of the tendons with the collateral vessels and nerves may be laid bare.
- and two named twigs. *Cutaneous palmar nerves.*—Some unnamed twigs are furnished to the integument from both the median and ulnar nerves in the hand; and two named cutaneous nerves ramify in the palm.
- One of median, *a.* One is an offset of the median nerve (p. 315), and crosses the annular ligament; it extends to about the middle of the palm, and is connected with the palmar branch of the ulnar nerve. A few filaments of this nerve are furnished to the ball of the thumb.
- other of ulnar nerve. *b.* The other palmar branch is derived from the ulnar nerve (p. 314); it has been traced already on the ulnar artery to the hand, and its distribution in the palm may be now observed.
- Palmaris brevis is subcutaneous, The PALMARIS BREVIS (fig. 45, ¹⁰) is a small subcutaneous muscle, about an inch and a half wide, whose fibres are collected into separate bundles. It is attached on the outer side to the palmar aponeurosis, and its fibres are directed inwards to join the skin at the inner border of the hand.
- and ends in the skin. This muscle lies over the ulnar artery and nerve. After it has been examined it may be thrown inwards.
- Palmar fascia. The *palmar fascia* or aponeurosis consists of a central and two lateral parts; but the lateral, which cover the muscles of the thumb and little finger, are so thin as not to require a separate notice.
- Its central part The *central part* is a strong, white, shining layer, which is pointed at the wrist; but it is expanded towards the fingers, where it covers nearly the width of the hand. Posteriorly the fascia receives the tendon of the palmaris longus, and is connected to the annular ligament; and anteriorly it ends in four processes, which are continued forwards, one for each finger, and form part of the sheaths of the tendons. At the point of separation of the processes one from another some transverse fibres are placed, which arch over the lumbricalis muscle and the digital artery and nerve that appear at this spot. From the four pieces into which the fascia divides, a few superficial longitudinal fibres are prolonged to the integument near the cleft of the fingers.
- ends in a piece for each finger, and in the skin

Dissection.—To follow one of the processes of the fascia to its termination, the superficial fibres must be first removed, and it must be then divided longitudinally by inserting the knife beneath it opposite the head of the metacarpal bone.

Ending of the processes.—The process of the fascia may be seen to send downwards an offset on each side of the tendons, which is fixed to the ligament connecting together the ends of the metacarpal bones, and to the borders of the metacarpal bone for a short distance. The same disposition exists in each of the processes.

The transverse ligament of the fingers is a thin fibrous band, which stretches across the roots of the fingers, and is contained in the fold of skin forming the rudiment of a web between them. Beneath it the digital nerves and vessels are continued onwards to their terminations.

Sheath of the flexor tendons (fig. 46).—Along each finger the flexor tendons are retained in position against the phalanges by a fibrous sheath. Opposite the middle of each of the two nearest phalanges the sheath is formed by a strong fibrous band (ligamentum vaginale), which is almost tendinous in consistence; but opposite the joints of the fingers it consists of scattered and oblique fibres that form a thin membrane. If the sheath be opened it will be found to be lined by a synovial membrane, which lubricates the tendons, and forms long and slender vascular folds (vincula vasculosa) between them and the bones.

Dissection.—The palmar fascia, and the thinner parts of the tendinous sheaths opposite the joints of the fingers, may be taken away. On the removal of the fascia the palmar arch of the ulnar artery and the median and ulnar nerves become apparent.

* The flexor and extensor tendons of the finger with accessory muscles. 2. Flexor sublimis tendon. 3. Flexor profundus tendon. 4. Extensor digitorum tendon. 5. Lumbricalis muscle. 6. Interosseous muscle.

Fig. 46.*



Ligament of the fingers.

Sheath of the tendons

varies in thickness.

Has a synovial sac.

Deep ending of the pieces of fascia.

- fourth, The *fourth* furnishes a nerve to the second lumbrical muscle, and divides to supply the contiguous sides of the fore and middle fingers.
- fifth, The *fifth*, like the fourth, is distributed by two branches to the opposed sides of the middle and ring fingers: it is joined by a branch from the ulnar nerve.
- Termination on the sides of the fingers. The *nerves on the fingers*.—On the sides of the fingers the nerves are superficial to the arteries, and reach to the last phalanx, where they end in filaments for the ball at the tip of the finger, and for the pulp beneath the nail. In their course forwards, the nerves supply chiefly tegumentary branches: one of these is directed backwards by the side of the metacarpal phalanx, and after uniting with the digital nerve on the back of the finger (p. 306), is continued to the dorsum of the last phalanx.
- Lateral off-sets. Dissection of the deep tendons. The *tendons of the flexor muscles* may be followed next to their termination. To expose them the ulnar artery should be cut through below the origin of the profunda branch; and the small superficial volar branch (of radial) having been divided, the palmar arch is to be thrown forwards to the fingers. The ulnar and median nerves are then to be cut below the annular ligament, and turned forwards. A longitudinal incision is to be made through the centre of the annular ligament, without injuring the small muscles that arise from it, and the pieces of the ligament are to be thrown to the sides. Finally the sheaths of the fingers may be opened for the purpose of observing the insertion of the tendons.
- Synovial sac surrounds tendons. FLEXOR TENDONS.—Beneath the annular ligament the tendons of the deep and superficial flexors are surrounded by a large and loose synovial membrane, which projects upwards into the forearm and downwards into the hand, and sends an offset into the digital sheath of both the thumb and the little finger.* In the hand the tendons of the deep flexor give attachment to the small lumbrical muscles.
- Tendons of superficial flexor. Tendons of the *flexor sublimis*.—The tendons of the flexor sublimis are superficial to those of the deep flexor beneath the ligament; and the four tendons are nearly on the same level, instead of being arranged in pairs as in the forearm.
- in the hand. After crossing the palm of the hand, they enter the sheaths of the fingers (fig. 46,²), and are *inserted* by two processes into the margins of the middle phalanx, about the centre.
- Insertion. When first entering the digital sheath, the tendon of the

* Theile refers the notice of this fact to M. Maslieurat-Lagémard, in No. 18 of the "Gazette Médicale" for 1839.

PALMAR PART OF THE ULNAR NERVE.—The ulnar nerve divides on the annular ligament or near it, into a superficial and a deep branch; these are distributed to one finger and a half, and to some of the muscles of the hand.

The *deep branch* accompanies the profunda artery to the muscles, and will be subsequently dissected with that vessel.

The *superficial branch* furnishes an offset to the palmaris brevis muscle, and some filaments to the integument of the inner part of the hand, and then ends in two digital nerves for the supply of both sides of the little finger and half the next:—

Digital nerves.—The more internal nerve is undivided, like the corresponding artery. The other is directed to the cleft between the ring and little fingers, and bifurcates for the supply of their opposed sides: in the palm of the hand this last branch is connected with an offset from the median nerve.

Along the sides of the fingers the digital branches have the same arrangement as those of the median nerve.

PALMAR PART OF THE MEDIAN NERVE.—As soon as the median nerve issues from beneath the annular ligament into the palm of the hand, it becomes enlarged and somewhat flattened, and divides into two nearly equal parts for the supply of digital nerves to the thumb and the remaining two fingers and a half. The more external of the two portions furnishes likewise a small muscular branch to the ball of the thumb. The trunk of the nerve and its branches are covered by the palmar fascia; and beneath them are the tendons of the flexor muscles.

a. The *branch to the muscles of the thumb* supplies the outer half of the short flexor, and ends in the abductor and opposens pollicis muscles.

b. The *digital nerves* are five in number. Three of them, which are distributed to the sides of the thumb and the radial side of the fore finger, are undivided, and are furnished by the external of the two pieces into which the trunk of the median divides. The other two spring from the inner piece of the nerve, and are bifurcated to supply the opposed sides of the middle and fore, and the middle and ring fingers.

The *first two* nerves belong to the thumb, one being on each side, and the most external communicates with branches of the radial nerve.

The *third* is directed to the radial side of the index finger, and gives a branch to the most external lumbrical muscle.

Dissection
of muscles
of thumb

Dissection.—The deep palmar arch of the radial artery and the interossei muscles will come into view if the flexor profundus is cut above the wrist, and thrown with the lumbricales muscles towards the fingers; but in raising the tendons the student should endeavour to preserve two small nerves that enter the two inner lumbrical muscles.

and little
finger.

The dissection of the short muscles of the ball of the thumb and the little finger is next to be prepared. Some care is necessary to make a satisfactory separation of the different small muscles of the thumb: those of the little finger are more easily defined.

Four mus-
cles in the
ball of the
thumb, viz.

SHORT MUSCLES OF THE THUMB.—These are four in number, and are named from their action on the thumb. The most superficial is the abductor pollicis; beneath it is the opponens pollicis, which will be recognised by its attachment to the whole length of the metacarpal bone. To the inner side of the last is the short flexor. And the wide muscle coming from the third metacarpal bone is the adductor of the thumb.

Abductor.

The ABDUCTOR POLLICIS is thin, about an inch wide, and is superficial to the rest. It *arises* from the upper part of the annular ligament at the radial side, and from the ridge of the os trapezium; and is *inserted* into the base of the first phalanx of the thumb. The muscle is subcutaneous, and rests on the opponens pollicis: it is connected oftentimes at its origin with a slip from the tendon of the extensor ossis metacarpi pollicis.

Attach-
ments.

Is the most
superficial.

Dissection.

Dissection.—The opponens pollicis will be seen on cutting through the abductor. To separate the muscle from the short flexor on the inner side, the student should begin near the farther end of the metacarpal bone, where there is usually a slight interval.

Opponens
fixed to
body of
metacarpal
bone,

The OPPONENS POLLICIS *arises* from the lower part of the annular ligament beneath the preceding, and from the os trapezium and its ridge; it is *inserted* into the front and outer border of the metacarpal bone for the whole length. This muscle is partly concealed by the preceding, though it is larger and projects on each side. Along its inner border is the flexor brevis pollicis. An insertion into the external sesamoid bone is described by M. Theile.

beneath
former.

Flexor
brevis

The FLEXOR BREVIS POLLICIS is the largest of the short muscles of the thumb: it consists of two pieces (inner and outer) at the insertion, but these are partly united at the origin.

arises by
outer and

The *outer head*, the smallest, arises partly beneath the

flexor sublimis conceals that of the flexor profundus ; but near the front of the first phalanx it is slit for the passage of the tendon of the latter muscle.

Dissection.—To see the tendons of the deep flexor and the lumbrical muscles, the flexor sublimis must be cut through above the wrist, and thrown towards the fingers. Some areolar tissue must be taken away.

Tendons of the flexor profundus.—At the lower border of the annular ligament the tendinous mass of the flexor profundus is divided into four pieces ; whilst in the forearm only the tendon of the fore finger is distinct from the rest. From the ligament the four tendons are directed through the hand to the fingers. At the root of the fingers each enters the digital sheath with a tendon of the flexor sublimis (fig. 46, ⁵), and having passed through that tendon, is inserted into the base of the last phalanx.

Between both flexor tendons and the bones are small membranous folds (ligamenta brevia), one for each. By means of this fold each tendon is connected with the fore part of the phalanx, and the capsule of the joint, immediately behind the bone into which it is inserted.*

The *lumbricales muscles* (fig. 46, ⁶) are four small fleshy slips that are connected with the tendons of the deep flexor. They arise from the side of the tendons near the annular ligament, and are directed to the radial side of the fingers, one for each, to be inserted into an aponeurotic expansion on the dorsal aspect of the first or metacarpal phalanx. These muscles are concealed for the most part by the tendons and vessels that have been removed ; but they are subcutaneous for a short distance in the hand between the processes of the palmar fascia. The outer two arise from single tendons, but each of the others is connected with two tendons.

Tendon of the flexor pollicis longus.—Beneath the annular ligament this tendon is external to the flexor profundus ; it then turns outwards between the heads of the flexor brevis pollicis, and is inserted into the last phalanx of the thumb. The common synovial membrane surrounds it beneath the annular ligament, and sends a prolongation, as before said, into its digital sheath.

* In the ligament to the long flexor tendon Mr. Marshall finds two thin bands of elastic tissue, which he names the *vincula subflava*. He assigns to those bands the office of drawing down the long tendons after bending of the fingers.—“On certain Elastic Structures connected with the Deep Flexor Tendons of the Fingers and Toes.” By John Marshall, F.R.C.S.—Med.-Chir. Review, Jan. 1853.

Dissection
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Abductor.

The ABDUCTOR POLLICIS is thin, about an inch wide, and is superficial to the rest. It *arises* from the upper part of the annular ligament at the radial side, and from the ridge of the os trapezium; and is *inserted* into the base of the first phalanx of the thumb. The muscle is subcutaneous, and rests on the opponens pollicis: it is connected oftentimes at its origin with a slip from the tendon of the extensor ossis metacarpi pollicis.

Attach-
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Is the most
superficial.

Dissection.

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beneath
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Flexor
brevis

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arises by
outer and

The *outer head*, the smallest, arises partly beneath the

opponens from about the outer two thirds of the annular ligament, at the lowest part, and from the os magnum.

The *inner head* has a wide origin from the os trapezoides inner head, and os magnum, from the sheath of the flexor carpi radialis, and from the bases of the second and third metacarpal bones.

The heads are soon blended in one mass; and this is and is inserted by two parts. inserted by two parts into the sides of the base of the first phalanx of the thumb,—the inner piece being united with the adductor, and the outer with the abductor pollicis. A sesamoid bone is connected with each lateral piece at its insertion. The tendon of the long flexor lies on this muscle, It is deep in the hand. and afterwards occupies the interval between the processes of insertion; and the deep palmar arch of the radial artery comes from beneath the inner head.

The ADDUCTOR POLLICIS is pointed at the thumb, and wide Adductor crosses from third metacarpal bone, at the opposite end. Its *origin* is fixed to the anterior or lower two thirds of the metacarpal bone of the middle finger, on the palmar aspect; and its *insertion* is attached, with that of the short flexor, to the inner side of the first phalanx of the thumb. joins short flexor. The cutaneous surface is in contact with the tendons of the flexor profundus and their lumbrical muscles; and the deep surface lies over (in this position) the abductor indicis in the first interosseous space, and the second and third metacarpal bones and the intervening muscles.

SHORT MUSCLES OF THE LITTLE FINGER.—There are commonly two muscles in the ball of the little finger,—an abductor and an adductor. Sometimes there is a short flexor muscle between the other two. Two or three muscles to little finger.

The ABDUCTOR MINIMI DIGITI is the most internal of the Abductor short muscles. It *arises* from the pisiform bone and the tendon of the flexor carpi ulnaris, and is *inserted* into the is the most internal. ulnar side of the base of the first phalanx of the little finger; an offset is sent from it to the extensor tendon on the back of the phalanx. The palmaris brevis partly conceals the muscle.

The FLEXOR BREVIS MINIMI DIGITI appears to be a part Flexor brevis is often absent. of the abductor. Placed at the radial border of the preceding muscle, it takes *origin* from the tip of the process of the unciform bone, and slightly from the annular ligament; is on the inner side of preceding. it is *inserted* with the abductor into the first phalanx. It lies on the adductor; and near its origin it is separated from the abductor muscle by the deep branches of the ulnar artery and nerve.

The ADDUCTOR vel OPPONENS MINIMI DIGITI resembles the Opponens opponens pollicis in being attached to the body of the meta-

carpal bone. Its *origin* is from the process of the unciform bone, and from the lower part of the annular ligament: its *insertion* is fixed into the ulnar margin of the metacarpal bone of the little finger. The adductor is partly overlaid by the preceding muscles; and beneath it the deep branches of the ulnar artery and nerve pass.

Dissection.—The radial artery comes into the palm of the hand between the first two metacarpal bones; and to lay bare the vessel, it will be requisite to detach the inner head of the flexor brevis pollicis at the origin. The deep palmar arch, and the branch of the ulnar nerve that accompanies it, together with their offsets, are to be dissected out. A fascia, which covers the interossei muscles, is to be removed, when the dissector has observed its connection with the transverse ligament uniting the heads of the metacarpal bones.

RADIAL ARTERY IN THE HAND.—The radial artery enters the palm of the hand at the first interosseous space, between the heads of the abductor indicis muscle; and after furnishing one branch to the thumb, and another to the index finger, turns across the hand towards the ulnar side, and forms thus the deep arch.

The *deep palmar arch* extends from the interosseous space, to the base of the metacarpal bone of the little finger, where it joins the communicating branch (*profunda*) and the digital branch to the little finger from the ulnar artery. Its convexity, which is but slight, is directed forwards, and its position is more posterior, or nearer the carpal bones, than that of the superficial arch. The arch has a deep position in the hand, and lies on the metacarpal bones and the interossei muscles. It is covered by the long flexor tendons, and in part by the inner head of the flexor brevis pollicis. The *branches* of the deep palmar arch are the following:—

a. Recurrent branches pass from the concavity of the arch to the front of the carpus; these supply the bones, and anastomose with the other carpal arteries.

b. Three perforating arteries pierce the interossei muscles, and communicate with the interosseous arteries on the back of the hand.

c. Usually there are three palmar interosseous arteries, which occupy the three inner metacarpal spaces, and terminate by joining the digital branches of the superficial palmar arch at the clefts of the fingers: these branches supply the interosseous muscles, and vary much in their size and distribution.

Branches of the radial artery.—As soon as the radial artery enters the hand, it gives off the large artery of the thumb, and the digital branch of the index finger :—

1. The *large artery of the thumb* (art. princeps pollicis) runs along the first metacarpal bone, between the abductor indicis and the flexor brevis pollicis, to reach the interval between the heads of the last muscle, where it divides into the two collateral branches of the thumb : these are distributed like the arteries of the superficial arch.

2. The *digital branch of the index finger* (art. radialis indicis) is directed over the abductor indicis, and beneath the short flexor and the adductor pollicis, to the radial side of the fore finger. At the free or anterior border of the abductor indicis this branch is connected by an offset with the superficial palmar arch ; and at the end of the finger it unites with the digital branch furnished to the opposite side by the ulnar artery.

The *deep branch of the ulnar nerve* accompanies the deep palmar arch of the radial artery as far as the muscles of the thumb, and terminates in branches to the adductor pollicis, the inner head of the short flexor, and the abductor indicis.

Branches.—Near its origin the nerve furnishes branches to the muscles of the little finger. In the palm it gives an offset to each palmar and dorsal interosseous muscle, and to each of the inner two lumbrical muscles, besides the terminal branches to the muscles before mentioned.

The *transverse metacarpal ligament* connects together the heads of the metacarpal bones. Its cutaneous surface is hollowed where the flexor tendons cross it ; and beneath it the interossei muscles pass to their insertion. To the posterior border the fascia covering the interossei muscles is united. This ligament should be taken away to see the interossei muscles.

The *INTEROSSEI MUSCLES* are so named from their position between the metacarpal bones, and are seven in number. Two muscles occupy each space, except in the first where there is only one, and they are inserted into the first phalanx of the fingers. They are divided into palmar and dorsal interossei ; but all the small muscles are evident in the palm of the hand, though some project more than the others.

The *palmar muscles* (fig. 47) are three in number, and are smaller than the dorsal set, although they are most prominent in the palm of the hand. Undivided at the posterior part, they arise from the palmar surface of the metacarpal bones of the fingers on which they act, viz. those of the fore,

Other branches of radial.

Digital artery of the thumb.

Digital artery of the fore finger.

Deep branch of ulnar nerve.

Muscular offsets.

Ligament of heads of metacarpal bones.

Seven interossei muscles.

divided into palmar and dorsal.

Number and origin of palmar.

Insertion. ring, and little fingers ; and they are inserted into the ulnar side of the fore, and the radial side of the other two digits

Action.

Fig. 47.*

Dorsal set.

Number.

Attach-
ment



(supposing the hand supine) : their attachments may be kept in mind by considering them adductors of the fingers before mentioned to the middle line of the second.

The dorsal interossei (fig. 48) extend farther back than the palmar set, and arise by a two-fold attachment to the lateral surfaces of the metacarpal bones between which they lie. The dorsal muscles are thus allotted to the digits :—two belong to the middle finger, one is connected with the radial side of the fore, and one with the ulnar side of the ring finger. They

and action.

may be considered abductors from the middle line of the second finger : thus the muscles attached to the fore and ring fingers will draw those digits from the middle one ; and the two muscles of the middle finger will carry this digit to the right and left of a line passing through its centre. The first or external muscle of this set is noticed separately below under the name abductor indicis.

Fig. 48.†



Common in-
sertion of
both sets.

Both sets of muscles have a similar termination (fig. 46, ^e) :—the fibres end in a tendon, which is inserted into the side of the first or metacarpal phalanx, and sends an expansion to join the aponeurotic covering on the dorsum of the bone.

First dorsal
interosseous

The *abductor indicis*, or the first dorsal interosseous muscle, arises from nearly the whole

* The three palmar interosseous muscles : they are named numerically from the outer side.

† Dorsal interosseous muscles of the hand, which are numbered, like the palmar set, from the outer to the inner side.

of the metacarpal bone of the index finger, and from the upper half of that of the thumb; and it is *inserted* into the radial side of the first phalanx of the fore finger. By the palmar surface the muscle is in contact with the adductor and flexor brevis pollicis; and by the opposite surface it is subcutaneous. The radial artery perforates it to enter the palm. is perforated by radial artery.

Dissection.—The attachments of the annular ligament to the carpal bones on each side may be next dissected out. To define the ligament the small muscles of the thumb and little finger must be taken from it. Before reading the description of this band, the ends of the cut ligament should be placed in apposition. Dissection.

The *anterior annular ligament* is a firm ligamentous band which arches over and binds down the flexor tendons of the fingers. It is attached externally to the front of the os scaphoides, and to the fore and inner part, as well as the ridge of the os trapezium; and internally to the unciform and pisiform bones. By its upper border it is connected with the aponeurosis of the forearm; and by its anterior surface it joins the palmar fascia. On the cutaneous surface lie the palmaris longus and the ulnar artery and nerve. Annular ligament of front of wrist.

Dissection.—Next follow the tendon of the flexor carpi radialis to its insertion, and dissect out more fully the attachment of the biceps and brachialis anticus muscles to the bones of the forearm. Dissection.

The *tendon of the flexor carpi radialis*, in passing from the forearm to the hand, lies in the groove in the os trapezium between the attachments of the annular ligament to the bone, but outside the arch of that ligament: here it is bound down by a fibrous sheath lined by a synovial membrane. The tendon is *inserted* into the base of the metacarpal bones of the index and middle fingers. Insertion of tendon of flexor carpi radialis.

The *insertion of the brachialis anticus* takes place by a broad thick tendon, about an inch in extent, which is fixed into the anterior rough part of the coronoid process of the ulna, and into the contiguous part of the bone. Insertion of brachialis anticus.

Insertion of the biceps.—The tendon of the biceps is inserted into the inner part of the tubercle of the radius, and slightly into the bone behind it. A bursa is found between it and the fore part of the tubercle. Near its attachment the tendon changes the direction of its surfaces; the anterior surface becoming external, and the opposite. The supinator brevis muscle partly surrounds the insertion. Insertion of the biceps tendon.

SECTION VI.

THE BACK OF THE FOREARM.

Position.—During the dissection of the back of the forearm the limb lies with the fore part undermost, and a small block is to be placed beneath the wrist for the purpose of stretching the tendons.

Take away
the super-
ficial vessels
and the
fascia.

Dissection.—The fascia with the cutaneous nerves and vessels is to be reflected from the muscles of the forearm, and from the tendons on the back of the hand; but a thickened band of it (posterior annular ligament), opposite the carpus, is to be left. If the integument has not been taken from the fingers, let the dissector proceed to remove it, in order that the tendons may be traced to the ends of the digits. The several muscles should be separated from one another up to their origin, especially the two radial extensors of the wrist.

Annular
ligament be-
hind the
wrist.

The *posterior annular ligament* consists of the special aponeurosis of the limb, thickened by the addition of some transverse fibres, and is situate opposite the lower ends of the bones of the forearm. This ligamentous band is connected at the outer part to the radius, and at the inner to the cuneiform and pisiform bones. It confines the extensor tendons, sending downwards processes which form sheaths for them, and are fixed to the bones beneath. The ligament will be subsequently examined more in detail.

Two layers
of muscles.

Superficial
has seven
muscles, viz.

MUSCLES ON THE BACK OF THE FOREARM.—The muscles are arranged in a superficial and a deep layer, as they are on the front of the forearm. The superficial layer is composed of seven muscles, which arise mostly by a common tendon from the outer condyle of the humerus, and have the under-mentioned position one to another. Proceeding from without inwards the student will find in succession the long supinator, the two radial extensors of the wrist (long and short), the common extensor of the fingers, the extensor of the little finger, and lastly the ulnar extensor of the wrist. There is one other small muscle near the elbow, the anconeus.

Supinator
longus

arises from
humerus,

The **SUPINATOR RADII LONGUS** (fig. 45, ^s) is contained partly in the arm and partly in the forearm, and limits on the outer side the hollow in front of the elbow. The muscle arises from the upper two thirds of the outer condyloid ridge of the humerus, and from the front of the external inter-muscular septum. The fleshy fibres end above the middle of

the forearm in a tendon, by means of which the muscle is *inserted* into the lower end of the radius close above the styloid process. and is inserted into radius.

In the arm the margins of the supinator are directed towards the surface and the bone, but in the forearm the muscle is flattened over the others, and its edges have an opposite direction, viz. from before backwards. Near its insertion the supinator is covered by two extensors of the thumb. Along its inner border below the elbow is the radial artery; and above the joint it is in contact with the brachialis anticus. Beneath this muscle are found the extensors of the wrist, the radial nerve, and the radius. Connections. Is the guide to the radial artery.

The EXTENSOR CARPI RADIALIS LONGIOR arises from the lower third of the outer condyloid ridge of the humerus, and from the front of the contiguous intermuscular septum. The muscle descends on the short radial extensor; and its tendon passes beneath the extensors of the thumb, and through the annular ligament, to be *inserted* into the base of the metacarpal bone of the index finger. Along its outer border is the radial nerve. Extensor carpi longus Insertion.

The EXTENSOR CARPI RADIALIS BREVIOR is attached to the capsular ligament of the elbow joint; and to the outer condyle of the humerus by a tendon common to it and the three following muscles, viz. the common extensor of the fingers, the extensor of the little finger and the ulnar extensor of the wrist: it takes origin also from aponeurosis on its under and inner sides. The tendon of the muscle is closely connected with the preceding, and after passing with it through the same compartment of the annular ligament, is *inserted* into the base of the metacarpal bone of the middle finger. Extensor carpi brevis is contained in the forearm. Insertion into metacarpal bone.

Concealed by the two preceding muscles, this extensor rests on the radius and on some of the muscles attached to it, that is to say, on the supinator brevis, and the pronator teres. Along the inner side is the common extensor of the fingers; and the extensors of the thumb come out between the two. Both the radial extensors of the carpus have usually a bursa at the insertion. Parts around it.

The EXTENSOR COMMUNIS DIGITORUM is single at its origin, but is divided inferiorly into four tendons. It arises from the common tendon, from aponeurotic septa between it and the muscles around, and from the aponeurosis of the limb. Near the lower part of the forearm the muscle ends in three tendons, which pass through a compartment of the annular ligament with the indicator muscle. Escaping from the Common extensor muscle. Origin.

ligament, the most internal tendon divides into two, and all four are directed along the back of the hand to their insertion into the last two phalanges of the fingers.

Insertion of the tendons into the phalanges.

On the back of the fingers the tendons have the following disposition :—Opposite the first two phalangeal articulations each tendon sends down lateral bands to join the capsule of the joint ; and on the dorsum of the first phalanx it forms an expansion with the tendons of the lumbricales and interossei muscles (fig. 46). At the anterior part of the first phalanx this tendinous expansion is divided into three parts :—the central one is fixed into the base of the second phalanx, whilst the lateral pieces unite at the front of the same phalanx, and are inserted into the base of the last. On the fore and little fingers the expansion is joined by the special tendons of those digits.

Connections of the muscle.

This muscle is placed between the extensors of the wrist and little finger, and conceals the deep extensors. On the back of the hand the tendons are joined by cross pieces.

Bands to the tendons.

Between the ring finger tendon and its collateral tendons these connecting bands are the strongest, and prevent the ring finger being raised during life if the other fingers are closed.

Extensor of little finger.

The *EXTENSOR MINIMI DIGITI* is the most slender muscle on the back of the forearm, and appears to be but a part of the common extensor. Its *origin* is in common with that of the extensor communis, but it passes through a distinct sheath of the annular ligament ; and its tendon, which is split into two directly afterwards, ends by joining the common expansion on the first phalanx of the little finger.

Common origin

and termination.

Extensor carpi ulnaris.

The *EXTENSOR CARPI ULNARIS* MUSCLE arises from the common tendon and from the aponeurosis of the forearm ; it is also firmly fixed by the fascia to the posterior border of the ulna below the anconeus muscle (about the middle third).

Origin.

Its tendon becomes free from fleshy fibres near the annular ligament, and passes through a separate sheath in that structure to be *inserted* into the base of the metacarpal bone of the little finger. Beneath this extensor are some of the muscles of the deep layer, with part of the ulna. On the outside is the extensor of the little finger.

Insertion.

Is the most internal muscle.

Anconeus has

a distinct origin

and insertion ;

The *ANCONÆUS* is a small triangular muscle near the elbow joint. It arises from the outer condyle of the humerus by a tendon distinct from, and on the ulnar side of the common tendon of origin of the other muscles. From this origin the fibres diverge to their *insertion* into the outer side of the olecranon, and into the impression on the upper third or

more of the posterior surface of the ulna. The upper fibres are nearly transverse, and are contiguous to the lowest in the triceps muscle. Beneath the anconeus are the supinator brevis muscle, and the recurrent interosseous vessels.

Dissection.—For the display of the deep muscles at the back of the forearm, and of the posterior interosseous artery and nerve, some of the superficial muscles, viz. the extensor communis, extensor minimi digiti, and extensor carpi ulnaris must be detached from their origin and turned aside: some small branches of the nerve and artery entering the muscles may be divided. The loose tissue and fat are then to be removed from the muscles, and from the ramifications of the artery and nerve; and a slender part of the nerve, which sinks beneath a muscle (extensor of the second phalanx of the thumb) about the middle of the forearm, should be carefully dissected. The separation of the muscles should be made carefully, because the small muscles of the thumb, especially the highest two, are not always very distinct from each other.

DEEP LAYER OF MUSCLES.—In this layer there are five small muscles, viz. one supinator of the forearm, and four special extensor muscles of the thumb and forefinger. The highest muscle, surrounding partly the upper end of the radius, is the supinator brevis. Below this are the three muscles of the thumb in the following order:—the extensor of the metacarpal bone, the extensor of the first, and that of the second phalanx. On the ulna the indicator muscle is placed.

The **EXTENSOR OSSIS METACARPI POLLICIS** (abductor pollicis longus) is the largest and highest of the extensor muscles of the thumb, and is sometimes united with the supinator brevis, below which it lies. It arises from the posterior surface of the radius for three inches below the supinator brevis; from a special impression of the ulna for the same distance, on the upper and outer part of the posterior surface; and from the intervening interosseous membrane. The tendon of the muscle is directed outwards over the radial extensors of the wrist, and through the outer compartment in the annular ligament, to be inserted mostly into the base of the metacarpal bone of the thumb, but also by a slip into the os trapezium.

The muscle is concealed at first by the common extensor of the fingers; but it becomes cutaneous between the last muscle and the extensors of the wrist about two inches

is close to the triceps.

Dissection of deep layer of muscles,

and interosseous vessels and nerve.

Five muscles in the deep layer, viz.

Extensor metacarpal pollicis has a wide attachment.

Insertion

The muscle is at first deep, but

afterwards
superficial.

above the end of the radius. Opposite the carpus the radial artery winds backwards beneath its tendon. The ulnar attachment is higher than the radial, and begins close below the insertion of the anconeus. Between the contiguous borders of this muscle and the supinator brevis the posterior interosseous artery appears.

Extensor of
first phalanx
of thumb

The *EXTENSOR PRIMI INTERNODII POLLICIS* is the smallest muscle of the deep layer, and its tendon accompanies that of the preceding extensor. Its *origin*, about one inch in width, is from the radius and the interosseous membrane, close below the attachment of the preceding muscle. Its fibres end in a tendon, which passes through the same space in the annular ligament as the extensor of the metacarpal bone, and is *inserted* into the metacarpal end of the first phalanx of the thumb. With respect to surrounding parts this muscle has the same connections as the preceding.

has a small
origin.

Insertion
into the
thumb.

Extensor of
second pha-
lanx

The *EXTENSOR SECUNDI INTERNODII POLLICIS* varies in the extent of its bony attachment. It arises from the ulna for three inches, in a line with and below the extensor of the metacarpal bone; and from the interosseous membrane below for one inch; but it may be connected oftentimes with the middle three fifths of the ulna. Its tendon of insertion, after passing through a sheath in the annular ligament distinct from that of the other two extensor muscles, is directed along the dorsum of the thumb to be fixed to the base of the last phalanx. It is covered by the same muscles as the other extensors of the thumb, but it becomes superficial nearer the lower end of the radius. Below the annular ligament its tendon crosses the radial artery, and the tendons of the extensors of the wrist.

lies alone in
the annular
ligament.

Insertion.

Is lower
than the
preceding
two.

Indicator
muscle.
Origin.

The *EXTENSOR INDICIS* (indicator muscle) arises from the ulna for three or four inches, usually below the middle and internal to the preceding, though the attachment may be carried upwards beyond the centre of the bone. Near the annular ligament the tendon becomes free from muscular fibres, and passing through the ligament with the common extensor of the fingers, is applied to the external tendon of that muscle, and blends with it in the expansion on the first phalanx of the fore finger. Until this muscle has passed the ligament it is covered by the superficial layer, but it is afterwards subaponeurotic.

It is applied
to the com-
mon exten-
sor,
and inserted
with it.

Dissection of
supinator
brevis.

Dissection.—To lay bare the supinator brevis, it will be necessary to detach the anconeus from the external condyle of the humerus, and to cut through the supinator longus and the radial extensors of the wrist. After those muscles have

been divided, the fleshy fibres of the supinator are to be followed forwards to their insertion into the radius; and that part of the origin of the flexor profundus digitorum, which lies on the outer side of the insertion of the brachialis anticus, is to be removed.

The SUPINATOR BREVIS arises from the orbicular ligament of the radius and the external lateral ligament of the elbow joint; from a depression below the small sigmoid cavity of the ulna; and from the external margin of the ulna below that depression for two inches. From this origin the fibres pass outwards, and are inserted into the upper third or more of the radius except at the inner part, reaching downwards to the insertion of the pronator teres, and forwards to the hollowed anterior surface.

Origin of short supinator;

and insertion into the radius.

This supinator is concealed altogether at the posterior and external aspects of the limb by the muscles of the superficial layer; and anteriorly the radial vessels and nerve lie over it. The lower border is contiguous to the extensor ossis metacarpi pollicis, only the posterior interosseous artery intervening. Through the substance of the muscle the posterior interosseous nerve winds to the back of the limb. The upper part of the radius is surrounded by the fleshy fibres of the muscle, except at the tubercle and along a slip of bone below it.

Overlying

and contiguous parts.

The *posterior interosseous artery* is an offset from the common interosseous trunk (p. 313), and reaches the back of the forearm above the ligament between the bones. Passing between the contiguous borders of the supinator brevis and extensor ossis metacarpi, the artery descends between the superficial and deep layers of muscles nearly to the wrist, where it ends by anastomosing with the carpal and anterior interosseous arteries. It furnishes many *muscular offsets*, and the following recurrent branch:—

Posterior interosseous artery

is between the two layers of muscles.

The *recurrent branch* springs from the artery near its commencement, and ascends through some fibres of the supinator, but beneath the anconeus, to supply the elbow joint, and to anastomose with a long branch of the superior profunda artery in the last named muscle.

Its recurrent branch.

The *posterior interosseous nerve* takes its origin from the musculo-spiral trunk in front of the outer condyle of the humerus, and winds backwards through the fibres of the supinator brevis. Escaped from the supinator, the nerve is placed between the superficial and deep layers of the muscles as far as the middle of the forearm. Much reduced in size at that spot, it sinks beneath the extensor of the second

Interosseous nerve.

Position to muscles.

- phalanx of the thumb, and runs on the interosseous membrane to the back of the carpus. Finally the nerve enlarges beneath the tendons of the extensor communis digitorum, and terminates in filaments to the ligaments and the articulations of the carpus.
- Termination on back of the carpus.** *Branches.*—This nerve furnishes offsets to all the muscles of the deep layer; and to those of the superficial layer with the exception of the three following, viz., the anconeus, the supinator longus, and the extensor carpi radialis longior.
- Its muscular offsets.** **RADIAL ARTERY AT THE WRIST.**—At the wrist the radial artery winds below the end of the radius to the back of the carpus, and enters the palm of the hand at the first interosseous space, between the heads of origin of the first dorsal interosseous muscle. At first the vessel lies deeply on the external lateral ligament of the wrist joint, and is beneath the tendons of the extensors of the metacarpal bone and first phalanx of the thumb; but afterwards it is more superficial, and is crossed by the tendon of the extensor of the second phalanx of the thumb. Offsets of the external cutaneous nerve entwine around the artery. Its *branches* are numerous, but inconsiderable in size:—
- Radial artery on back of wrist.** *a.* The *dorsal carpal branch* passes transversely beneath the extensor tendons, and forms an arch with the corresponding offset of the ulnar artery. From this arch branches descend to the third and fourth interosseous spaces, and constitute two of the three *dorsal interosseous arteries*.
- Connections with parts around.** *b.* The *metacarpal or first dorsal interosseous branch* reaches the space between the second and third metacarpal bones, and anastomoses, like the corresponding arteries of the other spaces, with a perforating branch of the deep palmar arch. Finally it is continued to the cleft of the fingers, where it ends by joining the digital artery of the superficial palmar arch, and giving small dorsal branches to the index and middle fingers.
- Branches are small.** *c.* Two small *dorsal arteries of the thumb* arise opposite the metacarpal bone, along which they extend, one on each border, to be distributed on its posterior aspect.
- To back of carpus.** *d.* The *dorsal branch of the index finger* is distributed on the radial edge of the metacarpal bone of that digit.
- Metacarpal branch.** The different *compartments* of the *annular ligament* may be seen more completely by dividing the sheaths of the ligament over the different tendons passing beneath. There are six different spaces, and each is lubricated by a synovial membrane. The most external one lodges the first two extensors of the thumb. The next is a large hollow for the
- Dorsal arteries of the thumb and fore finger.**
- Sheaths of the annular ligament are six.**
- Position from without inwards.**

two radial extensors of the wrist; and a very small space for the extensor of the second phalanx of the thumb follows on the ulnar side. Still to the inner side is the common sheath for the extensor of the fingers, and that of the fore finger; and there is a separate compartment for the extensor of the little finger. Internal to all is the space for the extensor carpi ulnaris. The last muscle grooves the ulna; Bones grooved by the tendons. but all the others, with the exception of the extensor minimi digiti which is between the bones, lie in hollows in the radius in the order mentioned above.

Dissection.—If the supinator brevis be divided by a vertical incision, and raised from the radius, its attachment to the bone will be better seen. To see supinator brevis,

The posterior interosseous nerve, and the offsets from its gangliform enlargement, may be traced more completely after the tendons of the extensor of the fingers and indicator muscle have been cut at the wrist. interosseous nerve,

The dorsal surface of the posterior interossei muscles of the hand may be cleaned, so that their double origin, and their insertion into the side and dorsum of the phalanges may be observed. Appearing between the heads of origin of these muscles are the posterior perforating arteries. and interosseal muscles.

SECTION VII.

LIGAMENTS OF THE ELBOW, WRIST, AND HAND.

Directions.—The ligaments of the remaining articulations of the limb which are still moist, may be examined at once, but should any of them have become dry, they should be softened with a wet cloth whilst the student is learning the others. Directions.

Dissection.—To make the necessary dissection of the ligaments of the elbow, the brachialis anticus must be taken away from the front, and the triceps from the back of the joint; the muscles connected with the outer and inner condyles, as well as the supinator brevis and the flexor profundus, are to be removed. With a little cleaning the four ligaments—*anterior, posterior, and two lateral*—will come into view. Dissection of the elbow joint.

The interosseous membrane between the bones of the forearm will be prepared by the removal of the muscles on both the anterior and posterior surfaces.

THE ELBOW JOINT (fig. 49).—In this articulation the Bones form-

ing the
elbow joint.

The liga-
ments are

External
lateral.

Internal
lateral is
wide.

Inferior
attach-
ment.

A notch on
inner side of
the joint.

Anterior
ligament is
thin.

Posterior
ligament is
weakest.

lower end of the humerus is received into the hollow of the ulna, so as to produce a hinge-like arrangement; and the upper end of the radius assists to form part of the joint.

Fig. 49.*



Where the bones touch the surfaces are covered with cartilage, and their articular ends are kept in place by the following ligaments:—

The *external lateral ligament* is a roundish fasciculus, which is attached by one end to the outer condyle of the humerus, and by the other to the orbicular ligament around the head of the radius. A few of the posterior fibres pass backwards to the external margin of the ulna.

The *internal lateral ligament* is triangular in shape. It is pointed at its upper extremity, and is connected to the inner condyle of the humerus. The fibres diverge as they descend, and are inserted in this way:—The anterior which are the strongest, are fixed to the inner edge of the coronoid process; the posterior are attached to the inner side of the olecranon; whilst the middle fibres join a transverse ligamentous band over the notch between the olecranon and the coronoid process. The ulnar nerve is in contact with this ligament; and a vessel enters the joint by an aperture beneath the transverse band.

The *anterior ligament* is thin, and its fibres are separated by intervals in which masses of fat are lodged. By its upper

margin the ligament is inserted into the front of the humerus, and by its lower margin into the anterior part of the coronoid process and the orbicular ligament. The brachialis anticus muscle covers it.

The *posterior ligament* is much thinner than the anterior, and is covered completely by the triceps muscle. Superiorly it is attached to the humerus above the fossa for the olecranon; and inferiorly it is inserted into the olecranon.

* The ligaments of the elbow joint, and of the shafts of the radius and ulna (Bourgery and Jacob).—1. Capsule of the elbow joint. 2. Oblique ligament. 3. Interosseous ligament. 4. Aperture for blood-vessels. 5. Tendon of the biceps.

Some few fibres are transverse between the margins of the fossa before mentioned.

Dissection.—Open the joint by an incision across the front near the humerus, and disarticulate the bones, in order that the form of the articular surfaces may be seen. Dissection.

The *synovial membrane* lines the joint, and can be traced from one bone to another along the inner surface of the connecting ligaments. It projects between the radius and the orbicular ligament, and serves for the articulation of the head of that bone with the small sigmoid cavity of the ulna. Synovial membrane.

Articular surfaces of the bones.—The humerus presents inferiorly two distinct articular surfaces for the bones of the forearm. The one for the radius is on the outer side, and consists of a rounded eminence (capitellum) on the front of the bone, which is covered with cartilage only on the anterior aspect. The surface in contact with the ulna is limited internally and externally by a prominent ridge, and hollowed out in the centre, like a pulley (trochlea): the external ridge corresponds with the interval between the heads of the radius and ulna. On the front of the humerus above the articular surface are two depressions which receive the coronoid process and the head of the radius during flexure of the joint; and on the posterior aspect is a large fossa for the reception of the olecranon in extension of the forearm. Lower end of the humerus.
One surface for radius,
another for the ulna;
also for coronoid process and radius, and olecranon.

On the end of the ulna there is a large excavation named sigmoid cavity, which is narrowed in the centre, but expanded in front and behind (fig. 50). A slightly raised line extends from front to back through the cavity, and is received into the hollow of the trochlea of the humerus in the motions of the joint. In the bottom of the cavity the cartilage is wanting completely, or for a greater or smaller distance across the articular hollow. End of the ulna.

The end of the radius presents a circular depression with a raised margin. In the bent state of the joint the depression of the radius is fitted on the outer eminence of the humerus, and the bone is thus supported during rotation of the limb. End of the radius.

UNION OF THE RADIUS AND ULNA.—The radius is connected with the ulna at both ends by means of distinct ligaments and a synovial membrane; and the shafts of the bones are united further by interosseous ligaments. Radius is joined to ulna.

Upper radio-ulnar articulation.—In this joint the head of the radius is received into the small sigmoid cavity of the ulna, and is kept in place by the following ligamentous band :— At the upper end by

orbicular
ligament

The *annular* or *orbicular ligament* (fig. 50, ⁵) is a strong fasciculus of fibres, about a quarter of an inch wide, which is placed around the prominence of the head of the radius,

around the
head of the
bone,

Fig. 50.*



and synovial
membrane.

Union of the
shafts.

and is attached to the anterior and posterior edges of the small sigmoid cavity of the ulna. Its upper border is connected with the ligaments of the elbow joint; but the lower is free, and is applied around the neck of the radius. The radius moves freely in the socket formed by the ligament and the cavity of the ulna.

The *synovial membrane* is a prolongation of that lining the elbow joint; it projects inferiorly between the neck of the radius and the lower margin of the annular ligament.

Ligaments of the shafts of the bones.

—The aponeurotic stratum connecting together the bones in nearly their

whole length consists of the two following parts:—

Radius is
joined in the
middle by
interosseous
membrane.

The *interosseous membrane* (fig. 49, ³) is a thin fibrous layer, which is attached to the contiguous margins of the radius and ulna, and forms an incomplete septum between the muscles on the front and back of the forearm. Superiorly the membrane is wanting for a considerable space, and through the interval the posterior interosseous vessels pass backwards. Some small apertures exist in it for the passage of vessels; and the largest of these (4) is about two inches from the lower end through which the anterior interosseous artery turns to the back of the wrist. The membrane gives attachment to the deep muscles. Most of its fibres are directed obliquely inwards towards the ulna, though a few on the posterior surface have an opposite direction.

This is deficient above.

By round
ligament.

The *round ligament* (fig. 49, ²) is a slender band above the interosseous membrane, whose fibres have a direction opposite to those of the membrane. By one end it is fixed to the front of the coronoid process, and by the other it is inserted into the radius below the tubercle. This ligament divides the space above the interosseous membrane into two parts. Oftentimes this band is not to be recognised.

* View of the orbicular ligament (5) of the radius, which retains the upper end of the bone against the ulna.—1. Olecranon, and 2. Coronoid process.

The lower radio-ulnar articulation cannot be well seen till The lower end after after the examination of the wrist joint.

Dissection.—To see the ligaments of the wrist joint, the Dissection. tendons and the annular ligaments must be removed from both the front and back; and the fibrous structures and the small vessels must be cleaned away carefully from the surface of the ligaments.

THE WRIST JOINT (fig. 51).—The lower end of the radius, Bones forming wrist and the first row of the carpal bones except the os pisiforme, enter into the wrist joint; and four ligaments main-

Fig. 51.*



tain in contact the osseous surfaces, viz., anterior and united by posterior, and two lateral. The ulna is shut out from this articulation by means of a piece of fibro-cartilage.

The *external lateral ligament* is a short and strong band, external which intervenes between the styloid process of the radius lateral, and the upper part of the scaphoid bone.

The *internal lateral ligament* is smaller than the external, internal but is longer than it. It is attached by one end to the sty- lateral,loid process of the ulna, and by the other to the rough,

* Front view of the articulations of the wrist joint, and of the carpal and metacarpal bones (Bourguery and Jacob).—1. Anterior ligament of the wrist joint. 2. Capsule of the joint of the metacarpal bone of the thumb with the os trapezium. 3. Pisiform bone, with its separate joint and ligamentous bands. 4. Transverse bands to the head of the metacarpal bones.

- upper part of the cuneiform bone. Some of the anterior fibres are continued to the pisiform bone.
- anterior and posterior ligament. The *anterior ligament* (fig. 51,¹) takes origin from the end of the radius, and is inserted into the first row of carpal bones, except the os pisiforme, at the anterior surface.
- The *posterior ligament* (fig. 53,¹) is membranous, like the anterior, and its fibres are directed downwards and inwards. Superiorly it is attached to the lower end of the radius; and inferiorly it is fixed, after the manner of the anterior ligament, to the first row of carpal bones on the posterior aspect.
- Dissection. *Dissection.*—To see the form of the articulating surfaces, the joint may be opened by a transverse incision through the posterior ligament, near the bones of the carpus.
- Surface of radius. *Articular surfaces.*—The end of the radius, and the fibro-cartilage uniting it with the ulna, form an arch for the reception of the carpal bones (fig. 52); and the surface of the radius is divided by a prominent line into an external triangular, and an internal square impression. The three bones of the first carpal row constitute a convex eminence, which is received into the hollow before mentioned, and the different surfaces correspond in this way;—The scaphoid bone is opposite the external mark (4) of the radius; and the semilunar bone touches the square impression (5), and all the triangular fibro-cartilage (Henle*), or the greater part of it; whilst the cuneiform bone is in contact with the capsule, and sometimes with a part of the triangular fibro-cartilage.
- Of first row of carpal bones. The *synovial membrane* has the arrangement common to simple joints. This joint communicates sometimes with the lower radio-ulnar articulation by means of an aperture in the fibro-cartilage separating the two.
- Surfaces touching. **LOWER RADIO-ULNAR ARTICULATION.**—In this articulation the convexity of the end of the ulna is received into a
- Synovial sac.
- Lower ends of radius and ulna joined by

* Handbuch der Systematischen Anatomie des Menschen, von Dr. J. Henle, 1855.

Anatomists describe the pyramidal bone as being opposite the triangular fibro-cartilage of the joint; but in the above cited treatise half of the semilunar bone is said to correspond with the fibro-cartilage, and the pyramidal bone with part of the capsule of the joint.

My attention was directed by Dr. Sharpey to the statement of Professor Henle, whilst this sheet was passing through the press; and I have been able to examine since three wrist joints. In two the semilunar bone corresponded with the fibro-cartilage; but in one joint both the semilunar and the pyramidal bones were opposite the cartilage—the part of the semilunar being about a third of its wrist joint surface.

In the dried pyramidal bone there is also a difference in the size of the wrist joint articular surface, as if it entered sometimes more largely into the joint.

concavity on the radius ;—an arrangement just the opposite to that existing between the upper ends of the bones. The chief bond of union between the bones is a strong fibro-cartilage ; but a kind of capsule consisting of scattered fibres, capsule surrounds loosely the end of the ulna.

The *triangular fibro-cartilage* (fig. 52, *) is placed transversely beneath the end of the ulna, and is thickest at its margins and apex. By its base the cartilage is fixed to the ridge which separates the carpal from the ulnar articulating surface of the radius ; and by its apex to the styloid process of the ulna, and to the depression at the root of that process. Its margins are united with the contiguous anterior and posterior ligaments of the wrist joint ; and its surfaces enter into the construction of different joints, viz. those of the wrist and the lower radio-ulnar articulation. Occasionally it is perforated by an aperture.

The *synovial membrane* (*membrana sacciformis*) is very loose, from which circumstance it has received its name, and ascends between the radius and the ulna : it is separated from that of the wrist joint by the triangular fibro-cartilage.

Dissection.—The articulation of the carpal bones will be prepared by taking away all the tendons from the hand, and cleaning carefully the surface of the connecting ligamentous bands between the several bones. To the pisiform bone there are distinct ligaments.

At the same time the ligamentous bands uniting the metacarpal with the carpal bones and with one another should be dissected.

UNION OF THE CARPAL BONES.—The several bones of the

* The wrist-joint opened to show the arch formed by the bones of the forearm with their uniting fibro-cartilage.—1. Ulna ; and 2, its styloid process. 3. Radius. 4. Surface of radius touching the scaphoid bone. 5. Surface of radius for part of the semilunar bone. 6. Triangular fibro-cartilage, corresponding with the semilunar bone, and sometimes with part of the pyramidal bone. An asterisk points to a piece of whalebone between the end of the ulna and the triangular fibro-cartilage.

Fig. 52.*



Attach-
ments

and connec-
tions.

Synovial
membrane.

Dissection
of carpal

and meta-
carpal
joints.

Bones are

- joined into two rows. carpus are united into two rows by dorsal, palmar, and interosseous bands; and the two rows are connected to each other by separate ligaments.
- How first row is formed. *Bones of the first row* (fig. 51).—The os semilunare is united to the contiguous bones, viz. the scaphoid and cuneiform, by a *dorsal* and a *palmar* transverse band, as well as by an *interosseous* ligament at the upper part of the contiguous surfaces. The pisiform bone is articulated to the front of the cuneiform bone by a distinct *capsule* and a *synovial* membrane (fig. 51, ³). It has further two special ligaments;—one of these is attached to the process of the unciform bone, and the other to the base of the fifth metacarpal bone.
- Separate ligaments of pisiform bone. The bones of the second row are connected together in the same way as those of the first row, viz. by a *dorsal* and a *palmar* band of fibres from one bone to another. Between the contiguous rough surfaces of the several bones are *interosseous* ligaments, one in each interosseous interval.
- Second row is like first. *One row with another*.—The two rows of carpal bones are connected by an anterior and posterior, and two lateral ligaments.
- The two rows are joined by anterior, The *anterior* ligament (fig. 51) consists of irregular fibres, and intervenes between the two rows on the palmar aspect.
- posterior, The *posterior* ligament, which is longer and looser, and the greater number of whose fibres are transverse (fig. 53) has a corresponding attachment on the dorsal aspect of the bones.
- and lateral ligaments. Of the *lateral ligaments* the external is the best marked, and extends between the os trapezium and the scaphoid bone; whilst the internal ligament reaches between the cuneiform and unciform bones.
- Dissection. *Dissection*.—After the division of the lateral and posterior ligaments, the one row of bones may be separated from the other, so as to allow the articular surfaces to be seen.
- Surface of each row in contact. *Articular surfaces*.—The first row of carpal bones, with the exception of the pisiform, forms an arch, whose hollow is turned towards the second. In the second row the os magnum and os unciforme present a condyloid projection, which is received into the arch before mentioned; whilst the two outer bones are much below the level of the others, and form a slight hollow for the reception of the outer part of the scaphoid bone.
- One synovial membrane for the carpal bones. One *synovial membrane* serves for the articulation of all the carpal bones, except that of the pisiform with the cuneiform bone. Lining the joint between the two rows of

the carpus, the membrane sends upwards and downwards prolongations between the individual bones. The offsets upwards are two, and they sometimes join the synovial membrane of the wrist joint; but the offsets in the opposite direction are three, and may be continued to all, or only some of the articulations between the four inner metacarpal with their carpal bones.

and four
inner meta-
carpal.

Fig. 53.*



UNION OF THE METACARPAL BONES (fig. 53).—The metacarpal bones of the four fingers are connected at their bases by the following ligaments:—A superficial *dorsal* and *palmar* fasciculus of fibres passes transversely from one bone to the next; and the bands in the palm are the strongest (fig. 51). Besides there is a short *interosseous* ligament between the contiguous rough surfaces of the bones.

Metacarpal
bones are
joined by
their bases

Lateral union.—Where the metacarpal bones touch they are covered by articular cartilage, and the surfaces are furnished with prolongations of the synovial membrane serving for their articulation with the carpus.

by side
union

At their anterior extremities the metacarpal bones are bound together by the *transverse ligament*, which has been examined in the dissection of the hand (p. 327).

and by their
heads.

* Posterior ligaments of the wrist, and the carpal and metacarpal bones (Bourgery and Jacob). 1. Posterior radio-carpal. 2. Carpo-metacarpal joint of the thumb.—3, 3. Transverse bands between the heads of the metacarpal bones.

Joint between carpal and metacarpal bones ;

that of the thumb ;

those of other fingers

through dorsal

and palmar bands.

Lateral band.

How seen.

Dissection.

Surfaces of

UNION BETWEEN THE METACARPAL AND CARPAL BONES.

—Most of the metacarpal bones of the fingers are articulated with the carpal bones after one plan. But the bone of the thumb has a separate joint with a synovial membrane.

a. The metacarpal bone of the thumb articulates with the os trapezium ; and the ends of the bones are incased in a separate capsular ligament (fig. 53, ^a). The joint is supplied with a *synovial* membrane which is simple in its arrangement.

b. The metacarpal bones of the fingers receive longitudinal bands from the carpal bones on both aspects, thus :—

The *dorsal ligaments* (fig. 53) are two to each, except to the bone of the little finger. The bands of the metacarpal bone of the fore finger come from the os trapezium and os trapezoides ; those of the third bone are attached to the os magnum and os trapezoides ; the bone of the ring finger receives its bands from the os magnum and os unciforme ; and to the fifth metacarpal bone there is but one ligament from the unciform bone. The *palmar ligaments* (fig. 51) are weaker and less constant than the dorsal. There is one to each metacarpal bone, except that of the little finger. These ligaments may be oblique in direction ; and a band may be divided between two bones, as in the case of the ligament attached to the os trapezium and the second and third metacarpals. Sometimes one or more may be wanting.

On the ulnar side of the metacarpal bone of the middle finger is a longitudinal or *lateral band*, which is attached above to the os magnum and os unciforme, and below to the rough ulnar side of the base of the above mentioned metacarpal bone. Sometimes this band isolates the articulation of the last two metacarpals with the unciform bone from the remaining carpo-metacarpal joint ; but more frequently it is divided into two parts, and does not form a complete partition between those joints.

This band may be seen by opening the articulation between the unciform and the last two metacarpal bones ; and by cutting through with care the transverse ligaments joining the third and fourth bones, so as to allow the separation of the fourth from the third metacarpal.

Dissection.—The articulating surfaces of the bones in the carpo-metacarpal articulation may be seen by cutting through the rest of the ligaments on the posterior aspect of the hand.

Articular surfaces.—The metacarpal bone of the fore

finger presents a hollowed articular surface, which receives the prominence of the os trapezoides, and articulates laterally with the os trapezium and os magnum. That of the middle finger articulates with the os magnum. The metacarpal bone of the ring finger touches the os magnum and the unciform bone. And the little finger bone is opposed to the os unciforme.

Synovial membranes.—Usually two synovial membranes are interposed between the carpal and metacarpal bones, viz. a separate one for the bone of the thumb, and offsets of the common carpal synovial sac (p. 344) for the others. Sometimes there is a distinct synovial sac for the articulation of the os unciforme with the two last metacarpals.

Interosseous ligaments.—The interosseous ligaments between the bases of the metacarpal bones may be demonstrated by detaching one bone from another. On forcibly separating the carpal bones their strong interosseous ligaments will appear, viz. one on each side of the os semilunare in the first row, and between all the bones in the second row.

Dissection.—For the examination of the joint between the head of the metacarpal bone and the first phalanx of the finger, it will be requisite to clear away the tendons and the tendinous expansion around it. A lateral ligament on each side, and an inferior thick band are to be defined. Another joint may be opened to see the articular surfaces.

The same dissection may be made for the articulations between the phalanges of the finger.

UNION BETWEEN THE METACARPAL BONES AND THE FIRST PHALANXES.—In these joints the convex head of the metacarpal bone is received into the glenoid fossa of the phalanx, and the two are retained in contact by the extensor and flexor tendons, and by the following ligaments:—

The *lateral ligaments* are the same on both sides of the joint. Each is triangular in form; it is attached by its upper part to the tubercle on the side of the head of the metacarpal bone, and ends below by being inserted into the side of the phalanx and the inferior ligament. The *inferior ligament* is a longitudinal band, which is fixed firmly to the phalanx, but loosely to the metacarpal bone. It is fibro-cartilaginous in texture, and is grooved for the flexor tendon: to its sides the lateral ligaments are attached.

Covering the upper part of the joint is the extensor tendon; this takes the place of a superior ligament, and sends down an expansion on each side which serves as a

Synovial membrane. capsule to the articulation. The *synovial* membrane of the joint is a simple sac.

Joint of thumb. In the articulation of the thumb two sesamoid bones are connected with the inferior ligament, and receive most of the fibres of the lateral ligaments.

Joints of the phalanges have UNION OF THE PHALANGES.—The ligaments of the first joint are similar to those in the metacarpo-phalangeal articulation, viz. two lateral and an inferior.

lateral and inferior ligament. The *lateral ligaments* are triangular in form ; each is connected by its apex to the side of the phalanx near the anterior part, and by its base to the contiguous phalanx and the inferior ligament. The *inferior ligament* has the same mode of attachment between the extremities of the bones as in the metacarpo-phalangeal joint, but it is not so strong as in that articulation. There is a simple *synovial membrane* present in the joint.

The articulation of the second with the last phalanx is like the preceding joint in the number and disposition of its ligaments ; but all the articular bands are much less strongly marked.

Surface of the bones. *Articular Surfaces*.—The anterior end of each phalanx is marked by a pulley-like surface. The posterior end of the phalanx presents a transversely hollowed fossa, and is provided with a crest which fits into the central depression of the opposite articular surface in the movements of the joint.

TABLE OF THE CHIEF ARTERIES OF THE UPPER LIMB.

The sub-clavian is continued in the arm by	1. Axillary artery . . .	Superior thoracic			
		acromial thoracic . . .	{	Muscular	
		long thoracic		inferior acromial	
		alar thoracic		humeral thoracic.	
		subscapular . . .	{	Dorsal artery	{ Infraac-
		anterior circumflex		muscular.	pular.
	2. brachial artery . . .	posterior circumflex.			
		To coraco-brachialis			
		superior profunda . . .	{	Muscular to triceps	
		nutritious/		and anconeus	
		inferior profunda . . .	{	anastomotic.	
	3. radial artery . . .	anastomotic		Muscular to triceps	
		muscular.		anastomotic.	
		Recurrent			
		muscular			
		superficial volar			
		posterior carpal			
		anterior carpal			
		metacarpal			
		dorsal of the thumb			
		of the index finger			
		princeps pollicis			
		radialis indicis			
		deep arch.	{	Recurrent	
				perforating	
				interosseous	
				communicating	
	4. ulnar artery . . .	Anterior recurrent			
		posterior recurrent			
		interosseous	{	Anterior	{ Nutritious
				posterior	muscular.
		muscular			{ Recurrent
					muscular.
		dorsal of the hand, or	{	Dorsal carpal	
		metacarpal		metacarpal or inter-	
		anterior carpal		osseous.	
		superficial arch	{	Communicating	
				four digital branches	
				cutaneous	
				muscular.	

TABLE OF THE SPINAL NERVES OF THE UPPER LIMB.

BRACHIAL PLEXUS gives off below the clavicle . . .	Anterior thoracic . . .	{	Superficial deep.	
	subscapular . . .	{	Superior inferior long.	
	circumflex . . .	{	Articular cutaneous to teres minor to deltoid.	
	nerve of Wrisberg . .			
	internal cutaneous . .	{	Small cutaneous anterior of forearm posterior of forearm.	
	musculo-cutaneous . .	{	To coraco-brachialis biceps and brachialis anticus cutaneous external of fore- arm articular to carpus.	
	median	{	To pronator teres to muscles of forearm, except flexor ulnaris and part of profundus anterior interosseous cutaneous palmar to muscles of thumb in part five digital branches.	
	ulnar	{	Articular to elbow to flexor carpi ulnaris to flexor profundus in part cutaneous branch of forearm and palm dorsal cutaneous of the hand superficial palmar division . .	{ Communicating two digital branches.
			deep palmar nerve.	
	musculo-spiral . . .	{	Internal cutaneous to triceps and anconeus external cutaneous to supinator and extensor radialis longus	
			posterior interosseous . . .	{ Muscular articular.
			radial	{ Cutaneous of back of thumb and of first two fingers and half the next.

CHAPTER IV.

DISSECTION OF THE THORAX.

SECTION I.

CAVITY OF THE THORAX.

THE cavity of the thorax is the space included by the spinal column, the ribs, and the sternum, and by certain muscles in the intervals between the pieces of the bony framework. In it the organs of respiration, and the heart with its great vessels are lodged; and through it the gullet, and some vessels and nerves are transmitted.

Dissection.—When the parts covering in front the bony parietes of the thorax have been examined and taken away, the cavity is to be opened by removing a part of the anterior boundary. To make a sufficient opening into the thorax, the sternum is to be sawn through opposite the interval between the first two ribs, and again between the insertion of the cartilages of the fifth and sixth ribs. After detaching the lining membrane (pleura) from the inner surface of the chest, the student is to cut through all the true ribs, except the first and seventh*, as far back as he can conveniently reach. The loose sternum and the ribs can be removed by dividing the intercostal muscles in the first and sixth spaces. The internal mammary artery may be cut across, and the bag of the pleura opened: when this has been done the cavity with its contents will be ready for examination.

The sternum and the cartilages of the ribs will be required hereafter for the dissection of the ligaments.

Form.—The cavity is of the same general form as the thorax, that is to say, irregularly conical, with the apex

* The student must be mindful to leave those ribs uncut. The division of them will not be advantageous to his own part, and will injure the dissection of the neck and abdomen.

On a cross section.	above and the base downwards; and it appears, from the collapsed state of the lungs, to be only partly filled by the contained viscera, but during life the whole of the now vacant space is occupied by the expanded lungs. On a horizontal section its shape would appear somewhat cordiform; for the cavity is flattened on the sides, is diminished in the middle line by the prominent spinal column, and is projected backwards on each side of the spine.
Parts bounding it	<i>Boundaries.</i> —The enclosing parts consist of the bones of the trunk, with certain accessory muscles both laterally and above and below, as in the following enumeration.
on sides, in front, behind.	On the sides the ribs with their intercostal muscles form the wall; whilst in front is the sternum; and behind is the spine with the muscles contiguous to it.
The base, its level, formed by diaphragm.	The base is constructed at the circumference by the last dorsal vertebra behind, by the end of the sternum before, and by the ribs on the side; whilst the space included by the bones is closed by the diaphragm muscle.
Its surface	The base is wider transversely than from front to back, and is on the whole convex towards the chest; though a closer inspection will show an undulating surface, and a different level at different points. Thus in the centre it is lower than at the sides, and is on a level with the xiphoid cartilage. On the right side it rises to a level with the upper border of the fifth rib near the sternum; and on the left, only to the corresponding part of the upper border of the sixth rib.* From these lateral projections, the diaphragm slopes suddenly towards its attachment to the ribs, but more behind than before, so as to leave a narrow interval between it and the wall of the chest. The level of this attached part will be marked by an oblique line over the side of the chest from the xiphoid cartilage to the eleventh rib; but it differs slightly on the two sides, being rather lower on the left.
and height.	
Its side level.	
Apex reaches into neck,	The apex of the space is continued higher than the osseous part of the wall, and reaches into the root of the neck. And the highest point is not in the centre, for there the windpipe, bloodvessels, &c. lie; but is prolonged on each side for an inch or an inch and a half above the first rib, so that the apex may be said to be bifid. Each point projects between the scaleni muscles, and touches the subclavian bloodvessels.
is bifid. How bounded.	

* This is the height in the dead body. The level to which it may reach in great respiratory efforts during life will be stated with the account of the Diaphragm.

In the interval between the apices are the several parts passing between the neck and the thorax.

Dimensions.—The hollow of the thoracic cavity does not correspond entirely with the thorax ; for the space included by the ribs is occupied below by the abdominal viscera, and above it reaches beyond the ribs into the neck. Size of chest not that of cavity;

In consequence of the arched condition of the diaphragm the depth of the space varies greatly at different points. At the centre, where the depth is least, it measures about seven inches, but at the back as much again ; and the other vertical measurements can be estimated by means of the data given of the level of the base to the wall of the thorax. depth varies ; before ; behind ; on sides.

Alterations in capacity.—The size of the thoracic cavity is constantly varying during life with the condition of the ribs and the diaphragm in breathing. Size is altered in life ;

It is increased in the horizontal measurements in inspiration, when the ribs are raised and separated from one another ; and is diminished in expiration as the ribs approach each other and the sternum sinks. in transverse dimensions by ribs ;

An alteration in depth is due to the condition of the diaphragm in respiration ; for the muscle descends when air is taken into the lungs, increasing thus the cavity ; and ascends when the air is expelled from those organs, so as to restore the previous size of the space, or in violent efforts to diminish it. But the movement of the diaphragm is not equal throughout, and some parts of the cavity will be increased more than others. For instance the central tendinous piece is joined to the heart case, and moves but slightly ; but the lateral, bulging, fleshy halves descend freely, and add greatly to the size of the lateral part of the chest by their separation from the thoracic parietes. in depth by the diaphragm, but un-^dequally.

The thoracic cavity may be diminished by the diaphragm being pushed upwards by enlargement, either temporary or permanent, of the viscera in the upper part of the abdomen ; or by the existence of fluid in the latter cavity. Thorax lessened by additions to abdomen.

THE PLEURÆ.

The pleuræ are two serous membranes, or closed sacs, which are reflected around the lungs in the cavity of the thorax. One occupies the right, and the other the left half of the cavity ; and it approaches its fellow along the middle line of the body, forming a thoracic partition, though the two do not blend. Sac of the pleura.

Each pleura is a sac of a conical shape, whose apex projects

- into the neck above the first rib, and whose base is in contact with the diaphragm. Its outer surface is rough, and is connected to the lung and the wall of the chest by areolar tissue, but its inner surface is smooth and secerning. Surrounding the lung, and lining the interior of one half of the cavity, the serous membrane consists of a parietal part or the pleura costalis, and of a visceral part, the pleura pulmonalis. The bags of the pleuræ approach one another in the middle line, as before said, and form a partition called mediastinum between the two sides of the cavity of the chest.
- Outer surface.** There are some differences in the shape and the extent of the two pleural bags. On the right side the bag is wider and shorter than on the left; and on the latter it is narrowed by the projection of the heart to the left side.
- Inner surface.** The continuity of the bag of the pleura over the lung, and along the wall of the chest, may be traced circularly from a given point to the same, in the following manner :—
- Disposition in thorax.** Supposing the membrane to be followed outwards from the sternum, it may be traced on the walls of the chest as far as the spinal column; here it is directed forwards to the root of the lung, and is reflected over the lung, covering its surface, and connecting together its different lobules. From the front of the root the pleura may be seen to course over the side of the pericardium to the sternum. Below the root the pleura gives rise to a thin fold, the *ligamentum latum pulmonis*, which intervenes between the inner surface of the lung and the side of the pericardium.
- Difference in sac of right and left side.** If the serous sac be traced above the root of the lung, it will be found to describe a circle without deflection over the viscus.
- The continuity is here traced over the lung** *The mediastinum.*—The median thoracic partition, or the mediastinum, is formed by the approximation of the pleural bags along the middle line, and is constructed of two membranes,—one being derived from each sac. But the two strata do not approach equally near throughout; for about midway between the sternum and the spine they are widely separated from one another by the heart. In front of the heart and behind it, however, the contiguous strata of the mediastinum may be distinctly seen near one another; and to the parts before and behind that viscus the terms “anterior and posterior mediastina” are sometimes applied, but it should not be forgotten that they are only portions of one great mediastinum or septum reaching from the sternum to the spine.
- and above it.** The part in front of the heart (anterior mediastinum)
- Along middle of chest the sacs form a partition.**
- Part of sep-**

extends from the pericardium to the back of the sternum, and is formed by the pleural bag of each side. Behind the second piece of the sternum the bags touch each other, but above and below that spot they are separated by an interval. The interpleural space in the anterior part of the mediastinum is narrowed at the centre, and is inclined below to the left of the middle line. In the upper part of the space are the remains of the thymus gland, and the origin of some of the hyoid and laryngeal muscles; and in the lower part is some areolar tissue, together with the triangularis sterni muscle of the left side.

turn in front of the heart

encloses space of hour-glass shape.

Contents.

The *part behind the heart* (posterior mediastinum) intervenes between the back of the pericardium with the roots of the lungs and the spinal column. Its lateral boundaries are the opposite pleural sacs, which are separated here by a larger interpleural space than in the front of the heart. If the pleura be divided behind the lung on the right side, the extent of the space will appear. In this space are contained the different bodies on the front of the spine, which pass along or out of the thoracic cavity, viz. the aorta, the vena azygos and the thoracic duct, the œsophagus with its nerves, the trachea, the splanchnic nerves at the lower part, and some lymphatic glands.

Part behind heart encloses a larger space.

The contents of the space.

Dissection.—The pleura and the fat are now to be cleaned from the side of the pericardium.

Clean pericardium and

The root of the lung is to be dissected out by taking away the pleura and the areolar tissue from its front and back, without injuring its several component vessels. In this dissection the phrenic artery and nerve will be found in front of the root, together with a few nerves (anterior pulmonary); the last are best seen on the left side. Behind the root of the lung is the large vagus nerve, dividing into branches.

the root of the lung.

Trace the nerves.

For the present, the arch of the aorta and the small nerves on it may be left untouched.

CONNECTIONS OF THE LUNG.

The lungs are two in number, and are contained in the cavity of the thorax, one on each side of the spinal column. In these organs the blood is changed in respiration.

Number

and use.

The lung is of a somewhat conical form, and takes its shape from the space in which it is lodged. It is unattached on all sides, except at the inner part where the vessels enter; and it is covered, as before said, by the bag of the pleura, except at the root. It presents for examination a base and

Form.

apex, with two borders and two surfaces ; it is divided also into lobes by fissures, and has a root formed out of the vessels and nerves entering its inner surface.

Base touches diaphragm.

Shape and level.

Apex is in the neck.

Anterior edge is thin.

Position on right and left side.

Posterior edge is thick.

External surface.

Internal surface

gives attachment to the root.

Division into lobes.

Left has two.

The base of the lung is hollowed, and fits on the convexity of the diaphragm ; but at its circumference is a thinned part, which projects into the narrow space between the muscle and the thoracic wall. Following the shape of that muscle, it is sloped obliquely from before backwards, and reaches in consequence much lower at the posterior than at the anterior edge. Its position with respect to the wall of the thorax may be ascertained externally by taking the level of the diaphragm as a guide (p. 352) ; and it must be remembered that the lung will be a rib's breadth lower in front on the left, than on the right side. The apex is rounded, and projects an inch to an inch and a half above the first rib, where it lies beneath the clavicle, the anterior scalenus muscle, and the subclavian artery.

The anterior edge or border is thin, and overlays in part the pericardium. On the right side it lies along the middle of the sternum as low as the sixth costal cartilage. On the left side it reaches its fellow, only pleura being between, as low as the fourth costal cartilage ; but below that spot it presents a V-shaped notch, whose apex is opposite the outer part of the cartilage of the fifth rib, and whose base is turned to the middle line. Two fissures are seen in this border of the right lung, but only one in that of the left lung. The posterior border is as long again as the anterior, and projects inferiorly between the lower ribs and the diaphragm ; it is thick and vertical, and is received into the hollow by the side of the spinal column.

On the outer aspect the lung is convex, and is in contact with the wall of the thorax. A large cleft divides this surface into two pieces (lobes of the lung), and on the right side there is a second smaller fissure. The inner surface is flat when compared with the outer, and is marked by the following inequalities :—Altogether in front, is the hollow corresponding with the heart and its large vessels, which is greatest on the left lung. Behind this, but nearer the posterior than the anterior border, is a fissure about three inches long, *hilum pulmonis*, which receives the vessels forming the root of the lung.

Each lung is divided incompletely into two parts or lobes by an oblique fissure, which begins near the apex, and ends in the anterior border near the base. From the form of the lung and the direction of the fissure, the lower lobe is neces-

sarily the largest. In the right lung a second horizontal fissure is directed forwards from the middle of the oblique one to the anterior border, and cuts off a small triangular piece from the upper lobe: this is the third lobe of the lung. Occasionally there may be a trace of the third lobe in the left lung.

and the right three lobes.

Besides the difference in the number of the lobes, the right lung is larger and heavier, and is wider and more hollowed out at the base than the left; it is also shorter by an inch. The increased length and the narrowness of the left lung are due to the absence below of a large projecting body like the liver, and to the direction of the heart to the left more than to the right side.

Difference in form and size of the lungs.

Root of the lung.—The vessels of the lung entering the fissure on the inner surface are bound together by the pleura and some areolar tissue; they form a foot-stalk or the root, which fixes the lung to the heart and the windpipe. The root is situate at the inner surface, about midway between the base and apex, and about a third of the breadth of that surface from the posterior border of the lung. In front of the root on both sides, are the phrenic nerve and the anterior pulmonic nerves, the former being at some little distance from it; and anterior to the right root is the descending cava. Behind on both sides, is the posterior pulmonic plexus; and on the left side there is, in addition, the descending aorta. Above on the right side is the vena azygos; and on the left side, the arch of the aorta. Below each root is the fold of pleura called ligamentum latum pulmonis.

Root of the lung.

Situation.

Connections.

In the root of the lung are found the vessels connected with the function of respiration, viz. a division of the air tube (bronchus), a branch of the pulmonary artery, and two pulmonary veins; together with small nutritive bronchial arteries and veins, and some nerves and lymphatics. These different parts have the following position to one another:—

Constituents of the root;

On both sides the bronchus is most posterior, the pulmonary veins most anterior, and the pulmonary artery between the other two constituents. In the direction from above downwards the position on the right side is, bronchus, pulmonary artery, and pulmonary veins; but on the left side the bronchus and artery have changed places, consequently the relative position will there be, artery, bronchus, and veins. This difference in the two sides may be accounted for by the left branch of the air tube being at a lower level than the right.

their relative position.

THE PERICARDIUM.

Situation. The bag that contains the heart is named the pericardium. It is situate in the middle of the thorax, in the interval between the pleuræ of opposite sides. Before proceeding with the anatomy of this sac, the following dissection should be undertaken :—

Clean vessels of heart *Dissection.*—Supposing the surface of the pericardium to be already cleaned, the student should next dissect out the large arteries and veins connected with the heart.

and seek small nerves crossing arch of aorta. The following nerves of the left side crossing the arch of the aorta should be sought carefully :—The nerve most to the left, and the largest, is the vagus ; the next largest in size on the right of the vagus is the phrenic nerve. Between the preceding nerves, and close to the coats of the artery, are the two following small nerves,—the left superficial cardiac nerve of the sympathetic, and the cardiac branch of the left vagus ; of the two, the last is the smallest, and to the right of the other.

Dissect superficial plexus in arch of aorta. The cardiac nerves from the left vagus and the sympathetic are to be followed onwards to a small plexus (superficial cardiac) in the concavity of the aorta. An offset of the plexus is to be traced downwards between the pulmonary artery and the aorta towards the anterior coronary artery of the heart ; and another prolongation is to be found coming forwards by the side of the arterial duct, from the deep cardiac plexus, to join the superficial one. When the pericardium is opened the nerves will be followed on the heart, but their dissection is difficult, and will require some care. Oftentimes these small nerves are destroyed in injecting the body.

Connections of the pericardium. The *pericardium* is larger than the viscus it contains. Occupying the interpleural space, it is situate behind the sternum, and projects below on each side of that bone, but much more towards the left than the right side. Somewhat conical in form, the wider part of the bag is turned towards the diaphragm, and the narrower part upwards towards the large vessels of the heart. Laterally, the pericardium is covered by the pleura, and the phrenic nerve and vessels lie in contact with it. Its anterior and posterior surfaces correspond with the objects contained in the fore and hinder part of the interpleural space ; and on the anterior aspect the bag is partly covered by the margins of the lungs, especially the left, in the manner stated. This

envelope of the heart consists of a fibrous structure, which is lined internally by a serous membrane.

Fibro-serous case.

The *fibrous* part surrounds the heart entirely, and is pierced by the different vessels entering that organ. It gives prolongations around the vessels passing through it, and the strongest of these sheaths is on the aorta. Inferiorly it is united by fibres to the central tendon of the diaphragm; but on the left side it extends beyond the limit of the tendon, and reaches the fleshy fibres of the muscle. This membrane is thickest at the upper part, and is formed of fibres crossing in different directions, many being longitudinal. When the pericardium has been cut open, the serous lining will be discernible.

Fibrous part gives sheaths to vessels.

Joins diaphragm.

Its structure.

The *serous sac* lines the interior of the fibrous pericardium, and is reflected over the surface of the heart. Like other serous membranes, the arachnoid for example, it has a parietal and a visceral part. After lining the interior of the fibrous case, to which it gives the shining appearance, the membrane is conducted to the surface of the heart by the different vessels. As it is reflected on the aorta and the pulmonary artery it contains those vessels in one tube, not passing between their contiguous surfaces; and at the posterior part of the pericardium it forms a pouch between the pulmonary veins of opposite sides. The cavity of the serous sac is lubricated by a little fluid.

Serous layer lines fibrous.

and covers surface of heart.

Peculiarities in its reflections.

The *vessels* of the pericardium are derived from the aorta, the internal mammary, the bronchial, the œsophageal, and the phrenic arteries.

Vessels.

THE HEART AND ITS LARGE VESSELS.

The heart is a hollow muscular body, and is divided into four compartments by septa. It is the centre of the vascular system, and the agent in the propulsion of the blood through the body. Into it veins enter, and from it the arteries issue.

This hollow body is centre of circulation.

Form.—When the heart is distended, its form is conical. Rather flattened from before backwards, and rounded on the left side, its surfaces and borders have differences which serve to distinguish them from each other:—thus the anterior surface is slightly convex, whilst the posterior is nearly flat; the left border is thick and round, but the right is thin, sharp, and less firm.

Form.

Surfaces and borders.

Size.—The size varies greatly, and in general the heart of the woman is smaller than that of the man. The measure-

Size.

ments may be said to be, commonly, four inches and three quarters in length, three inches and a half in width, and two inches and a half in thickness.

Situation in the chest; *Position and direction.*—The heart lies beneath the lower two thirds of the sternum, and projects on each side of it, but more on the left than the right side. Its axis is not parallel to, but is inclined obliquely across that of the body.

its axis The heart has not a vertical direction in the chest, with the base upwards and the apex down, but almost a horizontal one, with the base directed backwards to the right, and the apex forwards to the left side; and the left margin of the viscus is undermost, whilst the right is foremost.

placed almost horizontally. *Limits.*—The limits of the whole heart are the following :—

Limits The base is opposite the spinal column, and corresponds with the interval between the fifth and the eighth dorsal vertebrae. The apex strikes the wall of the thorax during life just below the fifth rib, near its junction with the cartilage; and at a spot on the surface, “two inches below the nipple and one on the sternal side” (Williams).

of base The upper limit would be a line across the sternum on a level with the upper border of the third costal cartilage. And the lower limit, a line over the junction of the sternum with the xiphoid cartilage, from the articulations of the sixth and seventh cartilages of the right side to the spot where the apex touches.

and apex, Its lateral limits are the following. On the right it projects from one to one inch and a half beyond the middle line of the sternum, and its increase in this direction is constantly varying with the degree of distension of the right half of the heart. On the left side the heart projects three inches to three inches and a half from the centre of the breast bone.

of upper margin, *Position to the wall.*—In consequence of the direction of the heart in the thorax, only some parts can be near, or in contact with the parietes in front. Thus the base will be directed away from the sternum and the costal cartilages, and the left half will be undermost and deep in the cavity; whilst the right half and apex will be directed forwards, and will correspond with the anterior wall, though mostly with lung intervening.*

lower border.

* If the dissector wishes for farther information respecting the correspondence of the different portions of the heart to points of the wall of the thorax, he may refer to the Papers by Dr. Sibson, in vol. xii. of the Trans. of the Provincial Med. and Surg. Association.

Component parts.—The heart is a double organ, and is made up of two similar halves, right and left. In each half are two hollow portions, an auricle and a ventricle ; these communicate, and are provided with vessels for the entrance and exit of the blood. The right half receives black blood by the systemic veins, and sends the same to the lungs by means of the pulmonary artery ; but the left half is supplied with red blood from the lungs by the pulmonary veins, and distributes it over the body through the aorta.

On the surface of the heart are certain grooves indicative of this composition. Thus passing circularly round the heart, nearer the base than the apex, is a groove which cuts off, as it were, the thin auricular, from the fleshy ventricular part. The auricular portion is placed at the base of the organ, and is subdivided into two halves (right and left) by a median partition. In like manner the ventricular portion is parted into right and left ventricles by a septum. The situation of the median partition between the ventricles is recognised by a longitudinal sulcus on each surface : this sulcus does not occupy the mid space either on the anterior or the posterior aspect, but is nearer the left border of the heart in front, and the right border behind ; so that most of the anterior surface is formed by the right, and the greater part of the posterior surface by the left ventricle.

The *auricles* are two (right and left), as before said, and are placed so deeply at the base of the heart, behind the aorta and the pulmonary artery, that only the tip of the right one comes forwards to the sternum. They receive their appellation from the resemblance that the tips or appendices, which project forwards on the sides of the arteries, bear to the dog's ears. The auricles are much thinner than the ventricles, and are recipients of blood from large veins. Of the two, the right is rather the larger and the more anterior ; it is joined by the upper and the lower cava, and by veins from the substance of the heart. The left auricle receives the two pulmonary veins of each side.

The *ventricles* constitute the fleshy part of the heart, and are thicker than the auricles, below which they lie. Two in number, like the auricles, each has an opening into the auricle of its own side, by which it receives blood ; and another opening into an artery, by which the blood is transmitted from the cavity. Their unequal extent on the aspects of the heart has been before alluded to :—thus the right ventricle forms the thin right border and the greater part of the anterior surface, and is prolonged upwards on the left

The heart is double.

each half having an auricle and ventricle.

Grooves marking position of

auricles

and ventricles ;

and partition between these :

right, most in front.

Number and situation of the auricles.

Veins join their cavities.

Right.

Left.

The ventricles communicate with arteries.

Number.

The right.

The left. into the pulmonary artery. The left ventricle enters alone into the apex, and constructs the left border, and most of the posterior surface of the heart : with its cavity the aorta is connected.

Dissect coronary vessels and nerves, *Dissection.*—Before opening the heart the vessels for the nutrition of its substance (coronary arteries) are to be dissected on the surface, together with the small nerves and veins that accompany them. The two arteries appear on the sides of the pulmonary artery, and occupy the grooves on the surface of the heart, where they are surrounded by fat. One branches over the right, and the other over the left side. With the anterior artery is a plexus of nerves, which is to be followed upwards to the superficial cardiac plexus ; and with the remaining artery is another plexus.

and coronary sinus. In the groove at the back of the heart between the auricles and ventricles, the student will find the large coronary vein, and the dilated coronary sinus in which it ends : the last should be defined and followed to its ending in the right auricle.

Two arteries of the heart, viz. The *coronary arteries* are two small vessels which are so named from their course around the heart ; they are the first branches of the aorta, and arise close above the semilunar valves. One is distributed on the right and the other on the left side of the heart.

right coronary, *a.* The *right coronary* branch appears on the right side of the pulmonary artery, and is directed onwards in the depression between the right auricle and ventricle to the posterior aspect of the heart, where it anastomoses with a similar circular offset from the left coronary artery. In this course branches are distributed upwards and downwards to the right half of the heart. Two of these are of larger size than the rest :—one runs on the anterior aspect of the right ventricle towards the free margin ; the other descends on the back of the heart, along the septum between the ventricles, and anastomoses towards the apex with the left coronary artery.

left coronary artery. *b.* The *left coronary* branch is inclined first behind the pulmonary artery to the left side of the vessel, then in the groove between the left auricle and ventricle to the back of the heart, where it anastomoses with the right coronary branch. Like the preceding artery, it furnishes offsets to the substance of the auricle and ventricle of its side. The largest of these descends in the anterior sulcus over the partition of the ventricles towards the apex, and communicates with the descending branch of the right coronary artery at the back of the heart.

The *veins* of the substance of the heart (cardiac) are not the same in number, nor have they the same arrangement as the arteries. There may be said to be three sets, but for the most part they are united into one large trunk, the coronary sinus, which opens into the right auricle.

The *coronary sinus* (fig. 54, *c*), will be seen on raising the heart to be apparently the dilated ending of the great coronary sinus:

Fig. 54.*



coronary vein. The points in its anatomy will be better seen if it is opened with a scissors. About an inch usually extent; in extent, it is limited on the one side by two valves at the opening of the great coronary vein into it; and on the other side by a large valve (Thebesian), where it opens into the right auricle. It is crossed by the muscular fibres of the left auricle. Inferiorly and at its inner termination it receives some branches from the back of the ventricles, whose openings are guarded by valves; and nearly at its outer termination is another vein without a valve,—the *oblique* vein of Mr. Marshall, which ascends along the back of the left auricle. structure;
veins join-
ing it.

a. The *great cardiac* or *coronary vein* (fig. 54, *d*) begins in front, near the apex of the heart, in the substance of the Large car-
diac vein is
single,

* Back of the heart, with its veins (Quain's Anatomy). *m.* Right auricle. *n.* Left auricle. *l.* Right ventricle. *o.* Left ventricle. *d.* Left auricular appendix, and under it is the great cardiac vein. *c.* The coronary sinus, joined by veins from the right side at its ending in the right auricle. *e.* Four pulmonary veins. *k.* Two pulmonary arteries. *f.* Aortic arch.

and opens into sinus. ventricles. From this origin the vessel turns to the back of the heart in the sulcus between the left auricle and ventricle, and opens into the coronary sinus. It receives collateral branches in its course, and its ending in the sinus is marked by two valves.

Small anterior and posterior cardiac veins. *b. Anterior and posterior cardiac veins.*—Some small veins on the anterior part of the right ventricle open separately, by one or more trunks, into the lower part of the right auricle. Similar small veins exist over the back of the ventricles; and one, larger than the rest, lies over the septum ventriculorum: they enter the coronary sinus by separate valved openings.

Smallest cardiac. *c. Smallest cardiac.*—A third set of veins (veins of Thebesius, *venæ minimæ*) lie in the substance of the heart: these are noticed in the description of the right auricle.

Cardiac nerves. *Cardiac nerves.*—The nerves for the supply of the heart are derived from a large plexus (cardiac) around the roots of the aorta and the pulmonary artery. Part of this plexus is superficial to the pulmonary artery, and part beneath it; and an offset is sent from each with a coronary artery. Only the superficial part of the plexus can be now seen.

Superficial plexus. The small *superficial cardiac plexus* is placed by the side of the ductus arteriosus, and below the arch of the aorta. The nerves joining it are the left superficial cardiac nerve of the sympathetic, the small (cervical) cardiac branch of the left vagus (p. 118), and a considerable bundle of nerves from the deep cardiac plexus. A small ganglionic mass is sometimes seen in the plexus. Inferiorly the plexus ends in nerves to the heart with the right coronary artery. A few filaments pass on the left division of the pulmonary artery to the front of the root of the lung of the same side.

Anterior coronary plexus, *a.* The *anterior* or *right coronary plexus* passes downwards from the plexus above described, to reach the right coronary artery, and receives near the heart a communicating offset from the right half of the deep cardiac plexus.

posterior plexus, *b.* The *posterior* or *left plexus* is derived, as will be subsequently seen, from the deep cardiac plexus, and accompanies the left coronary artery to the heart.

ending in the heart. On the heart the nerves at first surround the arteries, but they soon leave the vessels, and becoming smaller by subdivision, are lost in the muscular substance of the ventricles. On and in the substance of the heart the nerves are marked by small ganglia.

Four cavi-

The CAVITIES OF THE HEART may be examined in the order

in which the current of the blood passes through them, viz., first right auricle and ventricle, and afterwards left auricle and ventricle. ties of the heart.

Dissection.—In the examination of its cavities the heart is not to be removed from the body. To open the right auricle, an incision may be made in it near the free border, and from the superior cava nearly to the inferior cava; from the centre of that incision the knife is to be carried across the anterior wall to the auricula. By means of these cuts an opening will be made of sufficient size; and on raising the flaps with hooks or pieces of thread, and removing the coagulated blood, the cavity may be learnt. Dissection to open right auricle.

The CAVITY OF THE RIGHT AURICLE is of an irregular form,* though when seen from the right side, with the flaps held up as above directed, it has somewhat the appearance of a cone, with the base to the right and the apex below and to the left. Form of right auricle.

The *base* or wider part of the cavity is turned towards the right side, and at its extremities are the openings of the superior and inferior cavæ. Between those vessels the wall of the cavity projects a little, and presents a slight elevation in some bodies (tubercle of Lower). The *apex* is prolonged downwards towards the junction of the auricle with the ventricle, and in it is the large opening into the right ventricular cavity. Its base; apex.

The *anterior wall* is thin and loose. Near its upper part is an opening leading into the pouch of the appendix or auricula, which will admit the tip of the little finger. Around and in the interior of the appendix, are fleshy bands, named *musculi pectinati*, which cross mostly in a transverse direction, and form a network that contrasts with the general smoothness of the auricle. Anterior wall presents auricula.

The *posterior wall* corresponds for the most part with the septum between the auricles, in consequence of the position of the heart. On it, nearer the inferior than the superior cava, is a large oval depression, the *fossa ovalis*, which is the remains of an opening between the auricles in the fetus. Inferiorly the fossa merges into the opening of the lower cava. A thin semitransparent structure forms the bottom of the fossa, and there is oftentimes a small oblique aperture at its upper part. Around the upper three fourths of that hollow is an elevated band of muscular fibre, called *annulus* Posterior wall is marked by fossa ovalis.

* Sometimes the term cavity of the auricle is applied only to the appendix, and the term *sinus venosus* to the rest of the space here named auricle.

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The CAVITY OF THE RIGHT AURICLE is of an irregular form,* though when seen from the right side, with the flaps held up as above directed, it has somewhat the appearance of a cone, with the base to the right and the apex below and to the left. Form of right auricle.

The *base* or wider part of the cavity is turned towards the right side, and at its extremities are the openings of the superior and inferior cavas. Between those vessels the wall of the cavity projects a little, and presents a slight elevation in some bodies (tubercle of Lower). The *apex* is prolonged downwards towards the junction of the auricle with the ventricle, and in it is the large opening into the right ventricular cavity. Its base; apex.

The *anterior wall* is thin and loose. Near its upper part is an opening leading into the pouch of the appendix or auricula, which will admit the tip of the little finger. Around and in the interior of the appendix, are fleshy bands, named *musculi pectinati*, which cross mostly in a transverse direction, and form a network that contrasts with the general smoothness of the auricle. Anterior wall presents auricula.

The *posterior wall* corresponds for the most part with the septum between the auricles, in consequence of the position of the heart. On it, nearer the inferior than the superior cava, is a large oval depression, the *fossa ovalis*, which is the remains of an opening between the auricles in the fetus. Inferiorly the fossa merges into the opening of the lower cava. A thin semitransparent structure forms the bottom of the fossa, and there is oftentimes a small oblique aperture at its upper part. Around the upper three fourths of that hollow is an elevated band of muscular fibre, called *annulus*. Posterior wall is marked by fossa ovalis.

* Sometimes the term cavity of the auricle is applied only to the appendix, and the term *sinus venosus* to the rest of the space here named auricle.

Annulus of Vieussens. seu isthmus Vieussenii, which is most prominent above and on the inner side, and gradually subsides inferiorly. Altogether at the lower part of the posterior wall, between the opening into the ventricle and that of the inferior cava, is the aperture of the coronary sinus. Small apertures are seen scattered over the surface:—some lead only into depressions; but others are the mouths of veins of the substance of the heart (*venæ cordis minimæ*), and are named *foramina Thebesii*.

Apertures of cavæ. The chief *apertures* in the auricle are those of the two cavæ, of the coronary sinus, and of the ventricle. The position of the openings of the cavæ should be noted specially, because they are so placed as to prevent the mingling to any great extent of the currents of blood issuing from them in the fetus. The opening of the superior cava is in the front and top of the auricle, and its direction is downwards and somewhat forwards; whilst the inferior cava enters the lowest part of the auricle near the septum, and is directed inwards and backwards to the fossa ovalis.

Valves of chief apertures. All the openings, except that of the superior cava, have some kind of valve. In front of the inferior cava is a thin fold of the lining membrane of the cavity, the Eustachian valve, but in the adult this is only a remnant of a much larger structure in the fetus. This valve in its perfect state is semilunar in form, with its convex margin attached to the wall of the vein, and the other free in the cavity of the auricle. Its surfaces are directed forwards and backwards. In width the valve surpasses the vein opening, so that its extremities reach the surface of the auricle; and the left end is connected with the annulus, or the rim of the fossa ovalis.

One to coronary sinus. The free margin of the valve is often reticular. The aperture of the coronary sinus in the lower part of the auricle is closed by a thin fold of the lining membrane—valve of Thebesius. The auriculo-ventricular opening will be seen, in examining the right ventricle, to be provided with valves, which prevent regurgitation into the auricular cavity.

Auriculo-ventricular opening. In the adult there is but one current of blood in the right auricle towards the ventricle. But in the fetus there are two streams in the cavity of the auricle; one of pure, and the other of impure blood, which cross one another. The placental or pure blood entering by the inferior cava, is directed by the Eustachian valve chiefly into the left auricle, through an opening (*foramen ovale*) in the septum; whilst the current of systemic or impure blood, coming in by the

Course of blood in auricle in adult, and in the fetus.

superior cava, flows downwards in front of the other to the right ventricle.

Dissection.—Seizing the loose part of the right ventricle, the student should pass the scalpel through it below the opening from the auricle, and cutting downwards bring it out inferiorly near the apex of the heart without injuring the septum ventriculorum. A flap is thus formed, like the letter V, of the anterior part of the ventricle. In the examination of the cavity of the right ventricle, both the flap and the apex of the heart should be raised with hooks, so that the space may be looked into from below.

The CAVITY OF THE RIGHT VENTRICLE is triangular in form, and has the base turned upwards to the auricle of the same side. On a cross section the cavity would appear semilunar in shape, with the septum between the ventricles convex towards the cavity.

The apex of the cavity reaches the right border of the heart at a little distance from the tip. The base of the ventricle is sloped, and is perforated by two apertures; one of these, on the right, leading into the auricle, is the right auriculo-ventricular opening; the other on the left, and much higher, is the mouth of the pulmonary artery. The part of the cavity which communicates with the pulmonary artery is funnel-shaped, and is named infundibulum, or conus arteriosus.

The anterior wall, or the loose part of the ventricle, is comparatively thin, and forms most of the anterior surface of the ventricular portion of the heart. The posterior wall corresponds in greatest part with the septum between the ventricles, and is of considerable thickness.

Over the greater part of the cavity the surface is irregular, and is marked by projecting fleshy bands of muscular fibres, the columnæ carneæ, but near the aperture of the pulmonary artery the wall becomes smooth. The fleshy columns are of various sizes, and of three different kinds. Some form merely a prominence in the ventricle, as on the septum. Others are attached at each end, but free in the middle (trabeculæ carneæ). And a third set, which are fewer in number and much the largest, project into the cavity, and form rounded bundles, named muscoli papillares; these give attachment by their free ends to the little tendinous cords of the valve of the auriculo-ventricular opening.

The auriculo-ventricular orifice is situate in the base of the ventricle, near the right or free border of the heart, and is opposite the centre of the sternum, between the third

To open
right
ventricle.

Cavity of
right
ventricle.

Apex.
Base and its
openings.

Anterior
and
posterior
wall.

Interior of
the cavity is
uneven.

On it there
are three
sets of
fleshy
columnæ.

Opening
from the
auricle;

position;	costal cartilages: it is slightly larger than the corresponding
form;	aperture of the left side of the heart. It is oval from side to side, and its shape is maintained by a strong fibrous band that surrounds it. Prolonged from the circumference of the opening is a thin membranous valve, which projects into the cavity of the ventricle. Near its attachment to the heart the valve is undivided, but it is serrated, or divided into three chief points at its lower margin, and is named tricuspid; to this margin are attached small tendinous cords (chordæ tendinæ), which unite it to the muscular bundles of the ventricle.
is guarded by the tricuspid valve.	
Tricuspid valve;	The <i>tricuspid valve</i> is constructed by the lining membrane of the heart, which encloses some muscular fibres, as well as fibrous tissue. Its three slips or tongues are thus placed :—
how formed;	One is next the front of the ventricle; another is in contact with the posterior wall; and the remaining part, the largest and most moveable, is interposed between the apertures into the auricle and pulmonary artery. The central part of each tongue is strong, whilst the edges are thin and notched; and between the primary divisions there are sometimes secondary points (Kürschner). The tendinous cords that keep the valve in position ascend from the muscoli papillares in the intervals between the pieces of the valve, and are connected with each segment.* They end on the surface of the valve turned away from the opening in three different ways; some reach the attached upper margin of the valve; others enter its central thickened part; and the rest, which are much finer, end in the thin point and edge of the tongue of the valve.
divisions;	
attachment to tendinous cords.	
Its use.	During the contraction of the ventricle the valve is raised by the blood, so as to close the opening into the auricle, but the farther protrusion of it into the latter cavity is arrested by the small tendinous cords.
Mouth of pulmonary artery;	The <i>mouth</i> of the <i>pulmonary artery</i> will be seen when the incision in the anterior wall of the ventricle is prolonged upwards into it. It is situate on the left of the opening into the auricle, and is opposite the upper border of the third costal cartilage of the left side, close to the sternum.
position;	Into it the funnel-shaped part of the right ventricle or the infundibulum is prolonged, and in its interior are three
has three semilunar valves;	

* The papillary muscles are collected into two principal groups, whose tendons enter the interval on each side of the right or anterior tongue of the valve. In the interval between the left and posterior segments of the valve the tendinous cords are very small, and are connected with the septum.

semilunar or sigmoid valves. Each valve is attached to the side of the vessel by its convex border, and is free in the cavity by the opposite border, in which there is a slightly thickened and projecting nodule that has been named the *corpus Arantii*. their attachment.

The *semilunar valves* resemble in structure the tricuspid, for they are formed of fibrous tissue with a covering of the lining membrane. In the valves the fibrous tissue has a special arrangement :—There is one band along the attached margin ; a second along the free margin, which is connected with the projecting nodule ; and a third set of fibres is directed from the nodule across the valve, so as to leave a semilunar interval almost free from fibres near the free edge, which has been named *lunula*. Structure of sigmoid valves.
Arrangement of fibrous tissue.

The use of these little valves is obvious, viz. to give free passage to fluid in one direction, and to prevent its return by closing the area of the vessel. Whilst the blood is entering the artery the valves are placed against the wall ; but when the vessel acts on the contained blood the valves are thrown towards the centre of the cavity, and arrest the return of the circulating fluid into the ventricle. Their use.

Dissection.—To open the cavity of the left auricle the apex of the heart is to be raised, and a cut is to be made across the posterior surface of the auricle from the right to the left pulmonary veins. Another incision should be made in the auricula at right angles to the first. The apex of the heart must necessarily be raised during the examination of the auricle. To open left auricle.

The CAVITY OF THE LEFT AURICLE (fig. 55) is smaller than that of the right side.* Irregularly conical in shape, the wider part is turned towards the spinal column, and receives the pulmonary veins ; and the narrowed part opens inferiorly into the left ventricle. Shape of cavity of left auricle.

On the left side towards the upper part, is the aperture of the pouch of the auricula, which is narrower than on the right side. In the interior of the pouch, as well as around the entrance, are the fleshy fibres or the *musculi pectinati*, which resemble those before seen in the other auricle. On anterior wall is auricula.

On the part of the wall corresponding with the septum auricularum, is a superficial fossa of a semilunar form (fig. 55 e), the remains of the oval aperture through that partition ; this is bounded below by a projecting ridge, con- On septum, remnant of foramen ovale.

* The division of the cavity into auricle and sinus venosus may be made on this as on the other side.

cave upwards, which is the edge of the structure or valve that closed the opening in the fetus. This impression in the left auricle is above the fossa ovalis in the right cavity,

Fig. 55.*



because the aperture of communication between the two in the fetus was an oblique canal through the septum.

Openings :
four pul-
monary
veins,

The *apertures* in this auricle are those of the four pulmonary veins, two on each side, together with the opening of communication with the left ventricle. The mouths of each pair of pulmonary veins are close to one another ; those from the right lung open into the extreme right of the auricle near the septum, and those from the left lung enter the opposite part of the cavity, near the auricula. These veins are not provided with valves. The aperture into the ventricle will be seen afterwards to have a large and complicated valve, as on the right side, to guard it.

One into
ventricle.

Current of
blood in
adult ;

in fetus.

In the adult the blood enters this cavity from the lungs by the pulmonary veins, and passes to the left ventricle by the large inferior opening between the two. In the fetus, however, the lungs are impervious to the air and the mass

* Left auricle and ventricle laid open (Quain's Anatomy).

In the left auricle :—*a*. The septum auricularum. *c*. Four pulmonary veins. *e*. Fossa on the septum—the remains of the foramen ovale.

In the left ventricle :—*i*. Posterior flap of the mitral valve. *n*. The bundles of the muscoli papillares. *o*. Thick wall of the ventricle.

of the circulating fluid ; and the left side of the heart receives its pure blood at once from the right auricle through the aperture (foramen ovale) in the septum.

Dissection.—The left ventricle may be opened by an incision along both the anterior and the posterior surface, near the septum ; these are to be joined at the apex, and are not to be extended so far upwards as to reach the auricle. On raising the triangular flap the interior of the cavity will be seen.

How to
open left
ventricle.

The CAVITY OF THE LEFT VENTRICLE is longer, and more conical in shape than that of the opposite ventricle (fig. 55). and on a transverse section of the heart it is oval or almost circular.

Form of left
ventricle.

The *apex* of the cavity reaches into the apex of the heart, for the fibres of the left ventricle form alone this part. The *base* is turned towards the auricle, and is not sloped like that of the right ventricle. In it are the openings into the aorta and the left auricle.

Apex.

Base with
its open-
ings.

The *walls* of this ventricle are thickest, and the anterior boundary is formed by the septum ventriculorum.

Walls.

Its *surface* is irregular, like that of the right ventricle, in consequence of the projections of the fleshy columns, or the *carneæ columnæ* ; but near the great artery (aorta) leading from the cavity the surface is smooth. Three sets of fleshy columns are seen in this as in the right ventricle ; but the set which projects into the cavity, and receives the small tendinous threads of the valve, is the most marked. The *musculi papillares* spring from the front and back of the parietes, and are collected for the most part into two large muscular projections.

Inner sur-
face has
fleshy
columns.

and some
very large.

The *aperture* into the *left auricle* (auriculo-ventricular) is placed beneath the orifice of the aorta, but close to it, only a thin fibrous band intervening between the two. This opening is rather smaller than the corresponding aperture of the right side, and is longest like it in the transverse direction. Placed, as before said, beneath the aortic aperture, it extends also to the right, so as to lie beneath the left extremity of the right auriculo-ventricular opening. It is furnished with a membranous valve that projects into the ventricle ; but this is stronger and of greater length than the tricuspid, and has also firmer and more tendinous cords. Attached to a fibrous ring around the aperture, as well as in part to the aortic fibrous ring, the valve is divided below by a notch on each side into two instead of three pieces ; its segments lie one before another, having their edges

Left auri-
culo-ventri-
cular aper-
ture.

Form and
size.

Position.

It has a
large valve.

named mitral.	directed to the sides, and their surfaces towards the front and back of the cavity. From a fancied resemblance of it to a mitre it has been called the mitral valve. The anterior tongue of the valve intervenes between the auricular and aortic openings, and is attached above to the fibrous band in that position ; it is larger and looser than the posterior segment.
Mitral valve.	The <i>mitral</i> resembles the tricuspid valve in its structure and office. Its segments consist of thicker and thinner parts ; and in the notches at the sides there are also secondary pieces between the segments. The strong tendinous cords ascend to be attached to the valve in the lateral notches between the tongues ; and each of the large papillary muscles acts on both divisions of the valve. The ending of the tendinous cords on the surface of the segments is the same as in the tricuspid valve.
Attachment of cords.	
Aortic opening ;	The <i>opening of the aorta</i> , anterior to that of the auricle, is next the septum of the ventricles. By slitting up the
position and form.	side of the vessel without cutting the pulmonary artery, its aperture will be found to be round, and rather smaller than that of the pulmonary artery, beneath, and below which it lies. With respect to the wall of the thorax, it is opposite the lower border of the third left costal cartilage, behind the contiguous part of the sternum.
Is guarded by three sigmoid valves.	In its interior are three <i>semilunar</i> or <i>sigmoid</i> valves, which are larger and stronger than the corresponding parts in the pulmonary artery, but have a like structure, attachment, and use. The projection in the centre of each valve, viz. the corpus s. nodulus Arantii, is also better marked. Opposite each valve the coat of the aorta is bulged as in the pulmonary artery, though in a greater degree, and presents a little hollow on the inner side named <i>sinus</i> of Valsalva. Above the free margin of two of the small valves are the apertures of the coronary arteries.
Relative position of the apertures ;	<i>Position of the ventricular apertures.</i> Two openings have been seen in each ventricle, one of the auricle of its own side of the heart, and one of an artery. The apertures of the arteries (aorta and pulmonary) are nearest the septum ; and as the two vessels were originally formed from one tube, they are close together, but the pulmonary artery is the more anterior of the two. The aperture of communication with each auricle is nearer the circumference of the heart, and is posterior to the artery issuing from the fore part of the ventricle. The position of the openings to one another from before backwards, has been before referred
from before back.	

to;—viz. the right is partly before the left auriculo-ventricular; and the opening of the pulmonary artery is before that of the aorta, and rather higher than it.

STRUCTURE.—The heart is composed of strata of muscular fibres, and of certain fibrous rings with fibro-cartilage, which serve as fixed points for their attachment. These structures must be studied on a separate heart; or on that of the ox or sheep, in which the fibres have been hardened and the connective tissue destroyed by boiling, so that the fibres can be separated. The description of the structure of the heart may be omitted therefore till a suitable preparation of the fibres can be made.

Structure of the heart: fibrous and muscular.

The *fibrous structure* forms rings round the auriculo-ventricular and arterial orifices, and sends prolongations into the valves connected with those openings.

Fibrous bands

a. The *auriculo-ventricular rings* give attachment to the muscular fibres both of the auricles and ventricles, as well as to the framework of fibrous tissue in the tricuspid and mitral valves. These rings are distinct from the bands encircling the mouths of the arteries, except at the front of the left auriculo-ventricular opening, where the auricular and the arterial circles are blended.

form rings around auriculo-ventricular openings,

b. An *arterial ring* surrounds each large artery (aorta and pulmonary), fixing those vessels, and giving attachment to the muscular fibres and semilunar valves. It is a circular band, with an uninterrupted margin towards the ventricle, and a toothed or wavy margin towards the artery. In the margin connected with the vessel there are three notches, which are filled by corresponding projections of the artery, and give attachment internally to the sigmoid valves along their semilunar edges.

and around arterial openings.

To the last the sigmoid valves,

The artery is connected with the band of fibrous tissue in the following manner:—The middle coat presents three projecting convex pieces, which are received into and connected with the notches of the fibrous ring, but most intimately with the points; and the union between the two is strengthened externally by the parts around the vessel, and internally by the endocardium.

and middle coat of the artery are fixed.

Behind the aortic aperture is a *piece of fibro-cartilage*, with which the fibrous rings and the muscular substance are united.

Fibro-cartilago.

The *muscular substance* forms concentric bands of fibres, which are arranged mostly in a circular or spiral direction, and enclose the different cardiac cavities. In the auricles the fibres are quite distinct from those in the ventricles,

Muscular substance of heart is distinct in auricles and ventricles.

though both sets are attached to the fibrous circles around the cardiac orifices, as to a common point of origin or insertion. Some of the fibres enter the bases of the auriculo-ventricular valves. The fibres belong to the class of involuntary muscles, and yet they are marked with transverse striæ.

Disposition
in the
auricles,

In the *wall of the auricles* the fibres are mostly transverse (fig. 56, *a*), and are best marked at the lower part,

Fig. 56.*



where they
are trans-
verse,
annular
and ob-
lique.

though they form here but a thin layer; and some of the fibres dip into the septum between the auricular cavities. Besides this set there are annular fibres around the appendages of the auricles and the endings of the different veins. Lastly a few oblique fibres (fig. 56, *c*, *h*) pass upwards over the auricles, and are attached below, both in front and behind, to the fibrous rings surrounding the auriculo-ventricular orifices.

In the ven-
tricles they
pass from
base to
apex.

In the *wall of the ventricles* (fig. 57, *a*, *b*) the fibres are disposed in layers, which pass spirally downwards from the base towards the smaller part of the heart. At

* Muscular fibres of the back of the auricles (Gerdy).—*x*. Right, and *y*, left side of the heart. *d*. Pulmonary veins, and *v*, venæ cavæ. *a*. Transverse fibres of the auricle entering the septum. *c*. Oblique or looped fibres of the left, and *h*, corresponding fibres of the right auricle.

the apex of the cavity they make a sudden bend (*d*), and are reflected upwards with a straighter direction and a deeper position, to form the inner surface of the ventricle. To allow of this turning inwards of the fibres, the deepest layers extend the shortest distance from the base of the ventricle. Each ventricle has for the most part its own formative fibres, which assist in constructing the septum between the cavities. But some bands are concerned in the production of both ventricles on the anterior

The fibres of the ventricles are mostly separate,

Fig. 57.*



and posterior aspects of the heart ; for near the base of the ventricles the fibres are nearly circular in direction, and cross the interventricular grooves. When these intercommunicating fibres are divided, the ventricles may be detached from one another.†

but some common to both.

Endocardium.—Lining the interior of the cavities of the heart is a thin membrane, which is named endocardium in opposition to the external investment or pericardium. It is continuous on the one hand with the lining of the veins, and on the other with that of the arteries. Where the membrane passes from an auricle to a ventricle, or from a

Lining membrane of the heart

forms folds in the interior contain-

* Muscular fibres on the front of the ventricles (Reid).—*a*. Fibres of the right ventricle. *b*. Fibres of the left ventricle. *c*. Sulcus corresponding with the septum ventriculorum, which the fibres enter. *d*. Superficial fibres of the left ventricle, bending inwards and becoming deep. *e*. Apex of the left ventricle opened.

† For fuller detail concerning the structure of the heart, the student may refer to the article "Heart" in the *Cyclopædia of Anatomy and Physiology*.

ing fibrous
tissue.

ventricle to an artery, it forms duplicatures or valves, in which fibrous tissue is enclosed. In the ventricle it covers the tendinous cords of the valves, and the projecting muscular bundles. The thickness of the membrane is greater in the auricles than in the ventricles. In its structure it resembles a serous membrane.

Vessels of
the heart.

GREAT VESSELS OF THE HEART.—The arteries taking origin from the heart are the pulmonary artery and the aorta. The large veins entering the heart, besides the coronary, are the superior and the inferior cava, and the pulmonary veins.

The pul-
monary
artery

The **PULMONARY ARTERY** is a short thick trunk, which conveys the dark or impure blood from the right side of the heart to the lungs. From its commencement in the right ventricle the vessel is directed upwards on the left of the aorta; and at a distance of an inch and a half or two inches from its origin, it divides into two branches of nearly equal size for the lungs. Near the bifurcation of the artery is a small ligamentous cord, the remnant of the arterial duct, which passes from the left branch of the vessel to the arch of the aorta, and is named *ligamentum ductus arteriosi*. The trunk of the pulmonary artery is contained in the pericardium; and beneath it is the beginning of the aorta, together with the left auricle. On each side are the coronary artery and the auricular appendix.

is a short
trunk, and
divides into
two for the
lungs.

Con-
nec-
tions.

Right
branch is
longest.

The *right branch* is longer than the left. In its course to the lung it lies beneath the aorta and the vena cava superior, and rests on the bronchus or piece of the air tube: and as it passes outwards it is above the level of the right auricle of the heart. At the lung the artery divides into three primary branches, one for each lobe, which enter the pulmonic substance.

Left branch.

The *left branch* is rather smaller than the right; it is directed in front of the descending aorta and the left bronchus to the fissure of the root of the lung, where it divides into two branches, in accordance with the number of the pulmonic lobes.

Space at the
bifurcation.

As the right and left branches of the pulmonary artery pass outwards, they cross the tubes resulting from the division of the trachea, and enclose with them a lozenge-shaped space which contains some bronchial glands.

Condition of
the artery
in the fetus.

Ductus arteriosus. In the fetus the part of the pulmonary artery which is now ligamentous, was the continuation of the trunk of the vessel, and was larger than either branch to the lung. At that period the large vessel receives the

name arterial canal or duct (ductus arteriosus, Botalli), and opens into the aorta rather beyond the origin from the arch of the last great vessel of the head and neck.

As the lungs do not give passage to the circulating fluid *Use.* before birth, the impure blood of the pulmonary artery passes through the arterial duct into the aorta below the attachment of the vessels of the head and neck, in order that it may be transmitted to the placenta to be purified ; but after birth, when the function of the lungs is established, the current of blood is directed along the branches of the pulmonary artery instead of through the arterial duct. This channel becomes gradually smaller, when the blood has ceased to flow through it, and is quite obliterated before the eighth or tenth day.

The AORTA is the great systemic vessel which conveys the blood from the heart to the different parts of the body. The vessel first arches backwards to reach the spinal column, on which it extends through the chest and the abdomen. In the thorax the vessel is divided into two parts—arch of the aorta, and the descending or thoracic aorta. *This great vessel extends through chest and abdomen.*

Arch of the aorta.—The aorta has its origin in the left ventricle, close below the junction of the cartilage of the third rib of the left side with the sternum. From that point it ascends, curving backwards over the windpipe and the gullet, to reach the left side of the spinal column. And it loses the name of "arch" at the lower border of the body of the third dorsal vertebra. The arch has its convexity upwards and to the right, and its concavity to the root of the left lung ; and from it chiefly the large vessels for the supply of the upper part of the body take their origin. For the purpose of reducing to order the numerous connections of this portion of the aorta, the arch is divided into three parts—ascending, transverse, and descending. *Its first part is arched. The extent and divisions of the arch.*

The *first or ascending part* is about two inches in length, or slightly more, and is directed upwards behind, and very close to the sternum : it reaches as high as the upper border of the cartilage of the second rib on the right side, and is contained nearly altogether in the pericardium. At first the pulmonary artery is superficial to the aorta ; but, as the vessels take different directions, the latter is soon uncovered, and remains so to its termination. Behind it are the right branches of the pulmonary vessels. On the right side is the descending cava, and on the left, the pulmonary artery. Near the heart the vessel bulges opposite each semilunar valve, in the situation of the sinuses of Valsalva ; and *First part : length and connections.*

- there is sometimes another dilatation along the right side, which is named the great sinus of the aorta. The two coronary arteries arise close to the swellings first alluded to.
- Gives origin to coronary arteries.** The *second or transverse portion* recedes from the sternum, and reaches from the second right costal cartilage to the left side of the body of the second dorsal vertebra. It rests upon the trachea above its bifurcation, as well as over the oesophagus and the thoracic duct. Lying in front of this part of the artery are the pneumo-gastric, phrenic, and superficial cardiac nerves of the left side; and the first nerve sends backwards its recurrent branch beneath the vessel.
- Second part is transverse.** Along the upper border is the left innominate vein; and to the lower border, near its termination, the remnant of the arterial duct is attached. From this part arise the three great vessels of the head and the upper limbs.
- Connections.** The *third or descending part* of the arch is very short, extending only from the second to the lower part of the third dorsal vertebra. It lies against the third dorsal vertebra, and the fibro-cartilage between this and the second; and it is covered by the pleura of the left side of the chest.
- Gives origin to large vessels.** In the concavity of the arch of the aorta are contained the left auricle of the heart, the root of the left lung, the branching of the pulmonary artery with its arterial duct, and the left recurrent nerve. Deeper than these parts will be found the oesophagus and the thoracic duct, with some lymphatic glands.
- Third part is without branches.** The *branches* of the arch of the aorta are five in number; two come from the ascending, and three from the transverse part. The first two are the coronary arteries of the heart, which have been already noticed (p. 362). The other three are much larger in size, and supply the neck, the head, and the upper limbs. First on the right is the large trunk of the innominate artery; close to it is the left carotid; and last of all is the left subclavian, which is distant a short space from the preceding vessel.
- Parts contained in the arch.** *Peculiarities.*—The exceptions to the usual condition of the arch of the aorta, which the student may expect to find, concern the height and direction of the arch, and the position and number of its branches:—
- Five branches of the arch: two coronary, innominate, carotid, subclavian.** *Height.*—The arch reaches commonly to about an inch from the upper part of the sternum, but it may ascend nearly to the top of that bone, or stop an inch and a half or more from it.
- Peculiarities.** *Direction.*—Sometimes the aorta is arched over the root of the
- Height and**
- Direction of the arch.**

right instead of the left lung, as in birds; and is directed afterwards to its usual place on the spinal column, without any other change in the position of the viscera of the body. Or, all the viscera of the cavities of the thorax and abdomen being transposed, the arch of the aorta may share the general disturbance in position.

Position and arrangement of branches.—The large branches of the neck may have their usual origin (the highest part of the arch) moved more to the right; or their distance from one another may be increased or diminished. Position of the primary branches.

When there is transposition of the arch there is likewise a change in the arrangement of the branches;—the innominate artery supplying the left side, and the carotid and subclavian vessels of the right side having separate attachments to the arch. Transposition of branches.

Occasional branches.—Some smaller or *secondary arteries* take origin occasionally from the arch. The left vertebral artery arises most frequently from the arch, and is situated either between the left carotid and subclavian trunks, or beyond them. Occasionally a thyroid artery (lowest thyroid), or the right internal mammary, or both vertebrales, will be seen to spring from the arch of the aorta. Number increased by secondary branches.

The INNOMINATE ARTERY (brachio-cephalic) is the largest offset of the transverse part of the arch, and is the first of the three branches. It is a thick trunk, varying from one inch and a half to two inches in length. Ascending to the right beneath the sternum, it divides opposite the sterno-clavicular articulation into right carotid and subclavian arteries. Innominate artery ends in carotid and subclavian.

The artery is crossed by the left innominate vein, and is behind the upper piece of the sternum, and the origin of the hyoid and thyroid muscles. At first the innominate artery rests on the trachea, but as it ascends it is placed on the right of the air tube. On its right is the innominate vein of the same side, with the phrenic nerve. Usually no lateral branch arises from the artery. Length and connections.

Peculiarities.—The length of the artery may exceed two inches, or it may be only one inch or less: in these different states the place of bifurcation will be altered, being in the one case beyond, and in the other below the level of the upper border of the clavicle. Length may be altered;

Branches.—The left carotid is frequently joined with this artery at its origin. Or a branch to the thyroid body (art. thyroidea ima), or to the thymic body, or to the root of the lung, may arise from the innominate. branches from it.

Position.—The innominate artery is directed to the left side of the neck in cases of transposition of the arch. Position.

LEFT COMMON CAROTID ARTERY.—The common carotid artery of the left side of the neck springs from the arch of the aorta, and is therefore longer than the right by the distance between the arch and the top of the sternum. Left common carotid arises from arch of aorta.

In the thorax the artery ascends obliquely to the left Connections

in the
thorax.

sterno-clavicular articulation, but not close to the first piece of the sternum and the origin of the depressor muscles of the hyoid bone and larynx. In this course it passes beneath the left innominate vein, and the remains of the thymus gland. At first it lies on the trachea, but it crosses afterwards to the left of that tube, so as to be placed over the œsophagus and the thoracic duct. To its outer side is the left pneumo-gastric nerve, with one or more cardiac branches of the sympathetic nerve.

In the neck, the connections of the vessels of opposite sides are the same (p. 79).

Peculiarities
in its origin.

Peculiarities in origin.—The carotid is sometimes united with the innominate artery; or, should the innominate artery be absent, the common carotids, right and left, arise usually by one trunk. Its junction with the left subclavian is rare, except with transposition of the arch.

In position.

In position.—It seldom changes its relative position with respect to the other branches of the arch, but if this is altered it tends generally towards the right.

Left sub-
clavian
artery.

The LEFT SUBCLAVIAN ARTERY arises from the arch of the aorta, and ascends to the lower part of the neck through the upper aperture of the thorax. Beyond the first rib the vessels of opposite sides are alike (p. 70).

Course and
connections
in the
thorax.

The left subclavian trunk is directed almost vertically from the arch of the aorta to the inner margin of the first rib. In the thorax the vessel lies deeply, resting at first on the side of the œsophagus, and afterwards on the vertebral column and the longus colli muscle. It is invested by the left pleural bag in all its extent. On its inner side are the trachea and the œsophagus, with the thoracic duct. Somewhat anterior to the level of the artery, though running in the same direction, are the vagus nerve and some of the cardiac nerves.

Variations
in its origin
not fre-
quent.

Peculiarities in origin.—The left subclavian varies less than the other branches of the arch. Occasionally it arises in common with the left carotid, when the arch has its usual direction. Should there be transposition of the arch, the subclavian arises usually from an innominate trunk; but this is not a constant rule, for the subclavian, in such a condition of the vessels, may be the last on the arch, like the right vessel, and cross the front of the spinal column to take its place in the neck: or it may take origin, though rarely, from a dilatation connected with the remains of the arterial duct.

Right sub-
clavian may
arise from
the arch.

Right artery from the arch.—In some instances the right subclavian arises from the arch of the aorta; and it may be placed first, second, or third, though most frequently it is last on the arch. To

reach the inner margin of the first rib of the right side, when it is Its position.
last on the arch (most to the left), the artery is directed between the œsophagus and the vertebral column; or it may be, as in one instance, between the trachea and the œsophagus. The right subclavian may be also connected with a pouch,—the previous part of the ductus arteriosus, in the same way as the left subclavian. (See the work of Mr. Quain, "The Arteries," &c., p. 159).

VEINS OF THE HEART.—These are, as before said, the Veins of the heart are
superior and the inferior cava, and the pulmonary veins: the former are the great systemic veins which return impure blood to the right auricle; and the latter convey pure blood from the lungs into the left auricle.

The SUPERIOR OR DESCENDING CAVA is formed by the union of the right and left innominate veins, and brings to the heart the blood of the head, neck, upper limbs, and thorax. superior cava;

Its origin is on the right side of the sternum, opposite the interval between the cartilages of the first two ribs. From that spot the large vein descends to the pericardium, perforates the fibrous layer of that bag about one inch and a half above the heart, and ends in the right auricle. On its outer surface the vein is covered by the pleura of the right side, and the phrenic nerve is in contact with it. To the inner side is the ascending part of the arch of the aorta. Behind the vein is the root of the right lung. formed by innominate veins; ends in heart.

When the cava is about to perforate the pericardium it is joined by the large azygos vein of the thorax; and higher up it receives small veins from the pericardium, and the parts in the mediastinal space. Its branches.

The *innominate veins* are united inferiorly in the trunk of the descending cava. They are two in number, right and left; and each is formed behind the inner end of the clavicle, by the union of the subclavian and internal jugular veins of the same side of the neck. The trunks differ in length and direction, and in their connections with the surrounding parts. Innominate veins are right and left. How formed.

The *right vein* is about one inch and a half long, and descends vertically, on the right side of the innominate artery, to its junction with the vein of the opposite side. On the outer surface the pleura covers it, and along it the phrenic nerve is placed. Right, an inch and a half long;

The *left vein* is twice as long as the right, and is directed obliquely downwards above the level of the arch of the aorta, to join with its fellow in the superior cava. Between its origin and termination the vein crosses behind the sternum, and the remains of the thymus gland; and it lies left, twice as long and oblique in direction.

on the three large branches of the aortic arch, as well as on the several nerves descending over the arch.

Their branches.

The *branches* of these veins are nearly alike on the two sides. Each receives the internal mammary, the inferior thyroid, and the superior intercostal of its own side; and the left vein is joined in addition by some small thymic and pericardiac veins.

Sometimes they open separately into the heart.

Sometimes the innominate veins are not united in the vena cava, but descend separately to the heart, where both have distinct openings in the right auricle. When such a condition exists, the right vein takes the course of the upper cava; but the left vein descends in front of the root of the left lung, and turning to the back of the heart, receives the cardiac veins, before it opens into the right auricle. A cross branch is found connecting the two above the heart.*

This usual in fetus.

This occasional condition in the adult is a regular one in a very early period of the growth of the fetus; and two vessels are also persistent in some mammalia.

How two are changed into one.

Change of the two veins into one.—The changes that take place in the veins during the growth of the fetus, to produce the arrangement common in the adult, concern mostly the trunk on the left side. The following concise description may serve as an outline of them. First the cross branch between the two trunks enlarges, and forms the future left innominate vein. Next the left trunk below the cross branch disappears at its middle, and undergoes transformations at each end:—At the upper end it becomes converted into the superior intercostal vein. At the lower part it remains pervious for a short distance as the coronary sinus; and even the small oblique vein opening into the end of that sinus in the adult (p. 363), is a remnant of the part of the trunk of the vein that lay beneath the heart.

Forms coronary sinus.

Vestige in the pericardium.

Mr. Marshall finds in the adult another vestige of the occluded vessel in the form of a fold of the serous membrane of the pericardium in front of the root of the left lung: this he names the *vestigial fold* of the pericardium.

Inferior cava.

The INFERIOR or ASCENDING CAVA enters the right auricle as soon as it has pierced the diaphragm. No branches open into the vein in the thorax. The anatomy of this vein will be given with the vessels of the abdomen.

Four pulmonary veins.

The PULMONARY VEINS are two on each side; they issue from the fissure of the root of the lung, and end in the left

* An example of two large vessels, "double vena cava," opening into the heart in the adult, has been given to the College Museum by Dr. Sharpey. The student may consult an excellent treatise by Mr. Marshall on the development of the veins of the neck.—"Philosoph. Trans." for 1850.

auricle : their position to the other vessels of the root has been noticed at p. 357.

The right veins are longer than the left, and lie beneath the aorta and the right auricle of the heart. The superior one receives its roots from the upper and middle pulmonic lobes, and the inferior vein is formed by branches of the lower lobe. Right veins longest.

The left veins cross in front of the descending aorta ; and one springs from each lobe of the lung. Left veins.

Peculiarities in number.—The number of the pulmonary veins may be diminished by the union of those of the left side into one ; or may be increased by the want of union on the right side, from which three trunks result, corresponding with the three lobes of the lung. Their number varies :

But other peculiarities may be found as to number, for six or seven veins, taking both sides together, have been met with ; and a bronchial vein has been found opening into one of the left veins.

In the ending.—The veins of the right side have been observed to open in an adult into the vena cava. may open into the cava.

NERVES OF THE THORAX.

The pneumo-gastric and the sympathetic nerves supply the viscera of the thorax. Some other nerves (intercostal) which are contained in the wall of the thorax, will be afterwards dissected. In the cavity of the thorax is the phrenic nerve, which courses through the space to the diaphragm. Nerves of the thorax.

Dissection.—The phrenic nerve is sufficiently denuded for its examination ; but the student should trace the vagus nerve through the cavity. To trace the nerves,

The vagus is to be followed, on both sides, behind the root of the lung, and its large plexus in that position is to be dissected out : a few filaments of the gangliated cord of the sympathetic coming forwards to the plexus, must be looked for. In front of the root, the nerve supplies a few pulmonary filaments, especially on the left side. From the root of the lung the vagus is to be pursued along the oesophagus, by raising the lung and removing the pleura. particularly vagus.

The PHRENIC NERVE (internal respiratory) is a muscular branch from the cervical plexus to the diaphragm (p. 79). In its course through the thorax it lies along the side of the pericardium, and at a little distance from the root of the lung, with a small companion artery. When near the diaphragm each is divided into branches : these perforate the fleshy fibres, and are distributed on the under surface. The nerves Phrenic nerve is derived from the cervical plexus, and passes through thorax to the diaphragm.

of opposite sides differ in length, and in their connections above the root of the lung.

Right nerve
above root
of lung.

The *right* nerve is deeper at first in its position, and is also shorter and straighter than the left. As it enters the chest the nerve crosses behind the subclavian vein, but in front of the internal mammary artery; and it lies afterwards along the right side of the innominate vein and the superior cava till it comes in front of the root of the lung.

Left nerve
above root:

The *left* nerve has the same position to vessels as the right when entering the cavity, but it is directed in front of the arch of the aorta to the root of the lung; and, lower down, it makes a curve around the projecting heart. Before reaching the arch of the aorta the nerve is external to the left common carotid artery, and crosses the left vagus from without inwards, so as to be internal to that nerve on the arch.

is longer
than right.

Some off-
sets.

Branches.—Some small filaments are said to be furnished from the nerve to the pleura and pericardium; and occasionally the nerve is joined, near the upper part, by a twig from the branch of the nerve to the subclavius muscle.

Internal
mammary
artery

INTERNAL MAMMARY ARTERY.—A small part of this artery, which furnishes a branch to the diaphragm, has not yet been noticed. This part intervenes between the point of entrance of the artery into the chest (p. 74), and its course along the side of the sternum (p. 274). Lying beneath the first rib the vessel winds round the phrenic nerve and the innominate vein to reach the side of the sternum. It gives the following offset:—

winds
round aper-
ture of
thorax,

and gives
phrenic
branch.

The *superior phrenic branch* (comes nervi phrenici) is a very slender artery, which accompanies the phrenic nerve to the diaphragm, and is distributed to that muscle, anastomosing therein with the other arteries from the aorta, and with the musculo-phrenic branch of the internal mammary.

Vagus nerve
corresponds
on both
sides below
root of lung.

The **PNEUMO-GASTRIC NERVE** is one of the three trunks constituting the eighth cranial nerve (p. 116). Like the phrenic nerve, it passes through the thorax in its course from the neck to the abdomen. In the lower part of the thorax the nerves of opposite sides have a similar course, for they pass behind the root of the lung, each on its own side, and along the oesophagus to the stomach. But above the root of the lung, the right and left nerves differ as much as the phrenic. Each supplies branches to the viscera, viz., to the heart, the windpipe and lungs, and the gullet.

Right vagus
above the
root of the
lung,

The *right* nerve is posterior to the left in its position. As the nerve appears in the thorax, it lies between the sub-

clavian artery and the right innominate vein, and sends backwards a recurrent branch round the former. At first it is directed obliquely backwards, over the side of the trachea, to the interval between that tube and the œsophagus; and thus supported, the nerve reaches the posterior aspect of the root of the lung, where it forms the posterior pulmonary plexus. From the plexus two large offsets are continued to the œsophagus, and unite into one near the diaphragm: the trunk thus reconstituted, lies behind the gullet, and passes along it to the posterior surface of the stomach.

and on the back of the œsophagus below root.

The *left* nerve enters the thorax behind the left innominate vein, and to the outer side of the left common carotid artery. Lying between the left subclavian and common carotid arteries, the nerve courses over the arch of the aorta, then beneath the root of the lung, and forms there a larger plexus than on the right side. From the pulmonic plexus one or two branches pass to the front of the œsophagus, and join with corresponding branches of the right nerve in a plexus on that tube. Finally, the divisions of the nerve are collected into one trunk, which is continued on the front of the œsophagus to the anterior part of the stomach.

Left nerve above the root of the lung.

and on the front of the œsophagus.

The *branches* of the pneumo-gastric nerve in the thorax are the following:—

Branches are,

1. The *recurrent* or *inferior laryngeal* nerve is the first branch in the thorax. Arising on the right side on a level with the subclavian artery, and on the left at the lower border of the arch of the aorta, the nerve bends backwards to the trachea, along which it ascends to the larynx. On each side this branch is freely connected with the cervical cardiac branches of the sympathetic nerve, especially on the left side beneath the arch of the aorta.

recurrent laryngeal in the thorax.

2. *Cardiac branches* (thoracic).—Besides the cardiac branches furnished by the vagus in the neck, there are other offsets in front of the trachea to communicate with the cardiac plexus. These branches come from the trunk and the recurrent branch of the nerve on the right side, but they are supplied by the recurrent nerve alone on the left side.

Cardiac branches in the thorax;

The termination of the lower *cervical cardiac branch* of each vagus nerve (p. 118) may be now seen. The branch of the right vagus lies by the side of the innominate artery, and joins a cardiac nerve of the sympathetic from the neck; whilst the branch of the left vagus crosses over the arch of the aorta, and ends in the superficial cardiac plexus.

lower cardiac branch of the neck.

3. *Pulmonary branches*.—There are two sets of branches

Pulmonary branches.

for the lung, one to the anterior and the other to the posterior aspect of the root.

Small
anterior.

a. The anterior branches are two or three in number, and of small size, and communicate with filaments of the sympathetic on the pulmonary artery. These nerves are best seen on the left side.

Large
posterior
forms a
plexus.

b. The posterior branches are the largest and much the most numerous, and are obtained by the splitting of the trunk of the nerve after it has become flattened. Forming a plexiform arrangement (posterior pulmonary plexus) behind the root of the lung, these nerves are joined by filaments from the third and fourth ganglia of the knotted cord of the sympathetic, and are conveyed into the interior of the lung on the divisions of the air tube.

Esophageal
branches

4. *Esophageal branches* are furnished to the gullet all along the thorax, but in greatest abundance in the lower half. Below the root of the lung the branches of the pneumo-gastric nerves surround the cesophagus with a network, which has been named *plexus gular*.

form a
plexus.

Sympathetic
in thorax
consists of

SYMPATHETIC NERVE.—In the thorax the sympathetic nerve consists, as in the abdomen, of a knotted cord along each side of the spinal column, which communicates with the spinal nerves: and of a large prevertebral or cardiac plexus, which distributes branches to the viscera, viz. to the heart and the lungs.

a gangliated
cord,

The gangliated cord will be seen in a future stage of the dissection, after the heart and the lungs have been removed.

and a cen-
tral cardiac
plexus.

The **CARDIAC PLEXUS** lies at the base of the heart around the great bloodvessels. A part of this network, the superficial cardiac plexus, has been already described (p. 364). The remaining part, or the deep cardiac plexus, will be found beneath the arch of the aorta by means of the dissection given below.

Dissection
of the
plexus.

Directions.—The cardiac plexus has been injured by the previous examination of the heart; but, by following the directions now given, the student will obtain a knowledge of the disposition of the nerves, and will be able to make a complete dissection of them when the opportunity offers.

To find
the right
part.

Dissection.—The arch of the aorta is to be cut across with care, close above the pulmonary artery, and to be drawn well over to the left side: next, the descending cava is to be divided above the entrance of the vena azygos, and its lower part is to be thrown down. By the removal of some fibrous and fatty tissues and lymphatic glands, the right part of the plexus, in which the cervical branches of the sympa-

thetic and pneumo-gastric nerves of the right side are united, will be seen in front of the trachea, above the right branch of the pulmonary artery. The offsets to the heart should be followed downwards on the trunk of the pulmonary artery; and those to the lung should be traced along the right branch of that artery.

To lay bare the part of the plexus into which the cervical branches of the sympathetic and vagus nerves of the left side of the body enter, the arch may be cut through a second time, to the left of the junction of the ligamentum arteriosum with it; and that ligament is to be divided, so as to allow the transverse part of the arch to be turned upwards with the great vessels attached to it. The lymphatic glands and the areolar and fatty tissue are to be cleared away from the nerves, as on the opposite side; and the nerves are to be followed downwards to the heart, chiefly to the posterior coronary plexus.

In the *deep cardiac plexus* are united the several cardiac nerves derived from the ganglia of the sympathetic of both sides of the neck, except the highest nerve of the left side; and in it are collected also all the cardiac branches of the vagus nerves in both the neck and chest, with the exception of the lowest cervical cardiac branch of the left side. This large centre is situate between the trachea and the arch of the aorta, above the branches of the pulmonary artery; and from it nerves are furnished to the heart and the lungs. The several nerves entering the plexus are not intermingled in a ganglionic mass in front of the trachea; but those of the right side unite together on the corresponding part of the air tube, and those of the left half of the neck have a like disposition on their side.

a. The *right* part of the plexus is above the right branch of the pulmonary artery, and receives the nerves of the right side, viz. the cardiac nerves of the sympathetic in the neck; the cardiac branches of the trunk of the vagus, both in the neck and chest; and the cardiac offsets of its recurrent branch.

The branches of this half of the plexus are distributed mostly to the right side of the heart. From its lower end cardiac nerves pass downwards before and behind the right branch of the pulmonary artery. Those in front of the vessel run on the trunk of the pulmonary artery to the heart, and end in the anterior coronary plexus (p. 364). The other nerves, those behind the branch of the pulmonary artery, supply the right auricle of the heart. Offsets are also sent laterally on the branch of the artery to the root of the lung.

To expose
the left
part.

Nerves
entering the
deep cardiac
plexus.

Its situa-
tion;

is formed of
two parts,
right and
left.

Right part
how formed.

Branches
are distri-
buted to the
heart

by the ante-
rior coro-
nary plexus.

A few go to
root of lung.

Left part ;
nerves
entering it.

Offsets de-
scend to left
coronary
plexus

and to root
of lung.

Other car-
diac nerves
from the
neck.

All on the
right side
enter deep
plexus.

On left side
one enters
the super-
ficial, others
the deep
plexus.

b. The *left* half of the plexus is close to the ligamentum arteriosum, and rather on the left of the trachea. In it are collected the cardiac nerves of the sympathetic cord of the left side of the neck, except the highest, and in addition it has numerous and large branches of the left recurrent nerve of the vagus.

Nerves descend from it around the left branch to the trunk of the pulmonary artery, on which they are continued to the heart; and after supplying nerves to the left auricle, they terminate in the posterior coronary plexus (p. 364). A considerable offset is directed forwards to the superficial cardiac plexus by the side of the ligamentum arteriosum; and some nerves reach the left anterior pulmonary plexus by passing along the branch of the pulmonary artery to the lung.

The *cardiac branches* of the gangliated cord of the *sympathetic nerve* in the neck (p. 123), are now seen at their termination in the thorax. The nerves enter the chest on each side, over or beneath the subclavian artery, and join in the deep cardiac plexus, with the exception of the left superficial cardiac branch.

On the right side.—Though usually three in number, there may be but two cardiac nerves on this side, for the highest nerve is blended commonly with one of the other two. The middle and inferior nerves pass beneath the subclavian artery to the right half of the deep cardiac plexus. All three communicate with the branches of the recurrent laryngeal nerve of the vagus at the root of the neck, or in the upper part of the thorax, as well as with one another.

On the left side the superficial or highest cardiac nerve passes for the most part over the arch of the aorta, and ends in the superficial cardiac plexus, but it may give a branch beneath the arch to the deep plexus. Only one other nerve may be seen entering the left side of the deep cardiac plexus, for oftentimes the middle cardiac throws itself into the lower cardiac nerve.

THE TRACHEA AND THE LUNG.

To see the
trachea and
its divisions.

Dissection.—To see the bronchi or the divisions of the air tube in the root of the lung, it will be necessary to remove the pulmonary artery and its branches, together with the pulmonary veins. When the transverse part of the arch of the aorta, which has been already cut through, is turned to one side, the dissector will be able to clear away the bron-

chial glands, the nerves, and the fibrous tissue from the part of the trachea in the thorax, and from the branches into which it bifurcates.

The *TRACHEA*, or the air tube, reaches from the larynx to the lungs, and lies on the front of the spinal column. The tube begins at the lower part of the larynx, opposite the fifth cervical vertebra; and it ends at the third dorsal vertebra,* by dividing into two pieces (*bronchi*), one for each lung.

Trachea lies in the neck,

and in the thorax, where it ends in bronchi.

Its connections in the neck are described at p. 127, and its structure at p. 178. The part in the thorax remains to be studied.

In the thorax the trachea is situate with the great vessels in the space between the pleural bags. Here it is covered by the arch of the aorta, by the innominate and left carotid arteries, and by the cardiac plexus of nerves; and superficial to the arteries is the left innominate vein. Behind the air tube is the œsophagus, which is slightly inclined to the left near the arch of the aorta. On the right side are the vagus, and the innominate artery for a short distance after this has passed over the trachea; and on the left side is the vagus with its recurrent branch.

Its connections in the thorax.

The *bronchi*, or the branches of the air tube, are contained in the root of the lung, where they are surrounded by vessels, glands, and nerves. Near the lung each is divided into as many primary pieces as there are lobes to that viscus. In their structure and form the bronchi resemble the windpipe, for they are round and cartilaginous in front, but flat, and muscular and membranous behind. Their position behind the other pulmonary vessels has been described at page 357; but the characters of each are now to be noticed.

Bronchi lie in the roots of the lungs;

are like the trachea in form.

The *right* branch is about an inch in length, and is larger than the left; it passes outwards on a level with the fourth dorsal vertebra, and is placed above the right pulmonary artery: the vena azygos arches over it.

The right differs from the

The *left* branch is about two inches long. It is directed obliquely downwards through the arch of the aorta, and joins the root of the left lung a vertebra lower than on the opposite side. In this course the tubes lie on the œsophagus and the thoracic duct, and on the descending aorta; it is at first below the level of the corresponding pulmonary artery.

left branch.

Course and connections.

* The place of its bifurcation is sometimes opposite the fifth dorsal vertebra.

Dissection.—The lungs are to be removed next from the body in order that their physical characters and their structure may be learnt : they can be detached as soon as the vessels of the root are cut through.

The remains of the heart and pericardium are to be taken away afterwards. For their removal the inferior cava is to be divided, and the pericardium to be detached from the surface of the diaphragm ; and in removing the pericardium, some care should be taken by the dissector not to injure the parts contained in the interpleural space in front of the spine.

PHYSICAL CHARACTERS OF THE LUNG.—The surface of the lung is smooth and shining, and is invested by the pleura. Through the serous covering the mass of the lung may be seen to be divided by septa, into small irregularly-sized pieces or lobules. On looking closely at the pulmonary substance, especially at a thin margin, the texture will be perceived to be spongy, being composed of minute cells.

The tint of the lung varies with age. In infancy the colour is a pale red ; but in the adult the texture becomes grayish, and presents here and there dark gray spots or lines of pigment, whose shade deepens with increasing age, and becomes even black in old people. From the position of the body after death, the colour of the posterior border may be bluish black.

Consistence. * To the touch the lung is soft and yielding, and on a section the pulmonary substance will appear porous and spongy ; but the lung which is deprived of its air by pressure has a tough leathery feel. In the ordinary condition of the lung, slight pressure with the thumb and finger drives the air from its containing cells through the pulmonary structure, and produces the noise known as crepitation. If the lung contains serum, a frothy red fluid will run out when it is cut. The texture of the lung is very elastic ; this elasticity causing the organ both to diminish greatly when the thorax is opened, and to expel air that may be blown into it.

Specific gravity,

and weight of the lung. The specific gravity of the lung varies with the conditions of dilatation and collapse, or of infiltration with fluid. When the pulmonary tissue is free from fluid, and filled with air, it floats in water ; but when it is quite deprived of air it is slightly heavier than water, and sinks in that fluid. The weight of the lung is influenced greatly by the quantity of fluid or other material contained in its texture ; ordinarily it varies from eighteen to twenty one ounces, and the right

lung is about two ounces heavier than the left. In the male the lungs are larger, and slightly heavier than in the female.

Dissection.—By tracing the large branches of the bronchi, and the bloodvessels and nerves into the lung, the mode of branching of the air tubes will be apparent; and by inflating a part of the lung, the cellular structure may be seen. But the arrangement of the air cells about their tube, and the disposition of the different vessels, cannot be ascertained without injections and a microscope.

Follow
bronchi and
vessels into
the lung.

STRUCTURE OF THE LUNG.—The spongy pulmonary tissue consists of minute cells, in which the smallest branches of the air tube terminate; and the mass of the lung is formed by the collection of the cells into small groups or lobules, and by the aggregation of the lobules into larger masses or lobes. Each lobule is distinct from those surrounding it, and is furnished with its air tube and nerves, and with its own set of vessels concerned in both its function and nutrition.

Outline of
the elements
of the lung.

The constituents of the lung are united by a serous covering, which is prolonged continuously over the surface; and by a subserous layer of areolar tissue which penetrates into the interior, subdividing it into pieces. These several parts are examined more in detail below.

Covering
and uniting
medium.

Serous and subserous coverings.—The coat derived from the pleura is thin and transparent, and forms an entire capsule for the lung, except at the root where the vessels enter. The subserous areolar layer contains fibres of elastic tissue, and not only covers the surface, but extends inwards, establishing the division of the mass into lobules; where it separates the lobules it is named interlobular tissue, and is there free from fat.

Serous
covering

and areolar
tissue.

Bronchial branches in the lung.—When a bronchus is followed into the pulmonary structure, it is found to divide generally in a binary order, and to diminish in size at each subdivision, until one terminal offset appertains to a lobule. In the lobule the tube has a diameter of $\frac{1}{30}$ to $\frac{1}{50}$ of an inch. When this last degree of diminution is arrived at, the tubes give origin to the air cells.

Branches of
the bronchi
in the lung,

till they end
in cells.

The larger bronchial branches have the same constituent parts as the trachea, with a somewhat different arrangement; and they are round in the lung, instead of being hemispherical as in the trachea. The smallest branches, and the air cells, want some of the elements found in the larger bronchi; and those from which the cells spring are irregular

Difference in
large and
small tubes
in structure
and in form.

in shape, appearing to be spaces amongst the cells rather than tubes with continuous walls.

Constitu- ents of the air tube in the lung.	<i>Changes in the elements of the bronchi.</i> —The modifica- tions which the elementary parts constructing the air tube undergo in the bronchial divisions and in the air cells are the following :—The <i>pieces of cartilage</i> , which are regularly arranged in a line in the trachea, become broken up in the smaller bronchial tubes, and are scattered over the wall as irregular fragments. Becoming thinner and smaller as the subdivision of the air tube proceeds, they at last disappear, and are absent from the terminal branches. The <i>fibrous</i> and <i>elastic</i> tissues of the bronchial tubes are continued even to the air cells ; but in the small cell-bearing branches, the bundles of elastic tissue are diffused, and the two textures, much diminished in strength, are blended together to form the parietal structure. The <i>muscular fibres</i> , which exist at the back of the trachea, are diffused over the inner surface of the bronchi, where they have an annular arrangement, and extend along the air tube beyond the limit of the pieces of cartilage, but they cease where the cells begin to be formed. The <i>mucous membrane</i> becomes thinner as it ex- tends onwards along the air tube, and it is finally continued to the cells, where it is transparent. Its ciliated columnar epithelium is changed to scaly or pavemental in the air cells.
Pieces of cartilage.	
Fibrous and elastic tissue.	
Muscular fibres.	
Mucous membrane.	
Lobules, how formed.	<i>Lobules and lobes.</i> —A lobule is a cluster of air cells around a terminal branch of the air tube. Varying in size and shape, the lobule is invested by areolar tissue, and possesses its own offset of the air tube, as well as distinct branches of vessels and nerves. The larger masses of the lung, viz. lobes, are produced by the aggregation of the lobules.
Lobes.	
Nature and form of the air cells ;	The <i>air cells</i> are the little sacs or dilatations in which the smallest branches of the air tube terminate. They are poly- hedral in form, except on the surface of the lung, and are distinct one from another, save through the channel of the air passage. The cells are clustered in groups around the terminal branches of the air tube, and are situate both along the sides and at the extremity of the air passage, with which they communicate by large orifices. In size these small cells vary from $\frac{1}{200}$ to $\frac{1}{70}$ th of an inch, but they are larger on the surface and at the edges than in the deeper parts of the lung. The cell wall is formed by fibrous tissue, with some scattered fibres of elastic tissue, and is lined by a transparent mucous membrane possessing scaly epithe-
position on air tubes.	
Size.	
Structure.	

lumen.* Beneath the mucous lining is a network of the pulmonary vessels.

VESSELS OF THE LUNG.—Two sets of vessels are furnished to the lung, one being concerned in its function, the other in its nutrition. The vessels that convey blood to the lung to be aerated, or that carry the same away after it has been subjected to the respiratory process, are named pulmonary. The vessels connected with the nutrition of the structure are called bronchial.

Vessels of the lung are functional and nutritive, viz.

The *pulmonary artery* divides like the bronchus which it accompanies to the lobule. At the lobule the arterial branch is minutely subdivided, and its ramifications, entering the interlobular fissures, end in a capillary network in the wall of the air cells, beneath the mucous lining. The vascular circles of several cells (about twelve) communicate with each other.

pulmonary artery

The *pulmonary veins* begin in the vascular network before mentioned; and the twigs issuing from the several lobules are destitute of valves, and are united in larger tubes which course to the root of the lung. Although the small lobular branches of the arteries remain separate from one another, the corresponding veins anastomose together.

The *bronchial arteries* enter the lung on the air tube, and supply deep branches to the bronchial tubes and the contiguous glands, to the large bloodvessels, and to the interlobular areolar tissue of the lung, distributing offsets to the surface. On the smallest air tubes minute branches anastomose with offsets of the pulmonary arteries.

Bronchial artery

The *bronchial vein* begins by roots corresponding with the superficial and deep branches of the artery. Leaving the lung at the root, the vein ends differently on opposite sides of the body (p. 395).

and vein.

Nerves and lymphatics.—The lung receives nerves from the vagus and the sympathetic, and the offsets follow the branches of the air tube. Remak describes small ganglia on the sympathetic filaments. The *lymphatics* of the lung are both superficial and deep, and enter the bronchial glands at the root of the lung.

Nerves.

Lymphatics.

PARTS IN FRONT OF THE SPINE AND THE CORD OF THE SYMPATHETIC.

In front of the spinal column are several parts enumerated

* Some good observers deny the existence of an epithelial lining to the cells.

as lying in the interpleural space of the posterior half of the mediastinum, viz. the aorta, azygos veins, thoracic duct, œsophagus, and splanchnic nerves.

Dissection
of the parts
above men-
tioned,

Dissection.—The thoracic duct should be found first near the diaphragm, and on the right of the aorta: this slender vessel may be injected with tallow. Next, the areolar tissue is to be cleared away from the different parts before mentioned; and the thoracic duct is to be followed upwards beneath the arch of the aorta and along the œsophagus, till it leaves the upper aperture of the thorax. The azygos or intercostal veins, one on the right and two on the left of the aorta, should be likewise dissected.

and of sym-
pathetics.

After raising the pleura from the inner surface of the thorax, the gangliated cord of the sympathetic nerve will be seen lying along the side of the spinal column, over the heads of the ribs. Branches should be followed outwards from the ganglia to the intercostal nerves, and others should be traced inwards over the bodies of the vertebræ to form the three trunks of the splanchnic nerves.

Thoracic
aorta.

Extent.

Course,

and connec-
tions.

Branches.

Arteries of
the lung.

Distribu-
tion.

Two left,

The DESCENDING THORACIC AORTA is the part of the great systemic vessel which is above the diaphragm. Its extent is from the lower border of the third dorsal vertebra (the left side), where the arch ceases, to the front of the last dorsal vertebra. Contained in the interpleural space in front of the spine, the vessel is rather curved, lying at its upper part on the left, but at its lower part on the front of the spinal column. Beneath it are the vertebræ and the smaller azygos vein. In front of the vessel is the root of the left lung with the pericardium. On the left side it is covered by the pleura in all its length; and on the right side are the œsophagus and the thoracic duct, but near the diaphragm the former is placed over the aorta.

The *branches* of the vessel are distributed to the surrounding parts, and are named from their destination, viz. bronchial, pericardial, œsophageal, mediastinal, and intercostal.

1. The *bronchial arteries* supply the structure of the lungs, and arise from the front of the aorta, but their number and place of origin are liable to vary. These vessels adhere to the posterior part of the bronchial tubes, and so enter the interior of the lung, in which they ramify (p. 393); they give some twigs to the bronchial glands and the œsophagus.

For the left lung there are two arteries (superior and inferior), which arise from the aorta at a distance from each other.

The artery of the right lung arises in common with one of the left bronchial arteries (superior), or from the first intercostal artery of the right side.

Bronchial veins.—A vein issues from the root of each lung, to end in the following manner :—the right one joins the larger azygos vein ; and the left ends in the superior intercostal vein of its own side.

2. The *pericardial branches* are some irregular twigs that are furnished to the posterior part of the cardiac covering.

3. *Esophageal branches* arise at different points of the aorta, and are four or five in number. Ramifying in the structure of the gullet, these vessels anastomose with one another ; above they communicate with branches of the inferior thyroid artery near the pharynx, and below, with twigs of the coronary artery of the stomach.

4. Small *mediastinal branches* (posterior) supply the areolar tissue and the glands in the posterior part of the interpleural space.

5. The *intercostal arteries* are commonly nine or ten in number on each side, and are furnished to the same number of the lower intercostal spaces. To the other one or two upper spaces branches are supplied from the intercostal artery of the subclavian trunk. These small vessels arise from the posterior part of the aorta, and run outwards on the vertebræ, beneath the cord of the sympathetic nerve, to the intercostal spaces, where each divides into an interior and a posterior branch. In this course the upper arteries have a somewhat oblique, and the lower a transverse direction. As the aorta lies on the left of the spine the right vessels are the longest, and pass beneath the cesophagus, the thoracic duct, and the azygos veins ; they supply many twigs to the bodies of the vertebræ on which they lie.

a. The *anterior branch* is the continuation of the common trunk in direction and size, and continues onwards between the muscular strata nearly to the anterior third of the intercostal space, where it ends in two branches that anastomose with the intercostal arteries of the internal mammary (p. 275). At first this artery lies in the centre of the intercostal space, beneath the pleura and a fascia between the intercostal muscles, and resting on the external intercostal layer ; but near the angle of the rib it ascends to the upper boundary of the space. Accompanying the artery are the intercostal nerve and vein,—the vein being commonly above, and the nerve below it ; but in the upper spaces the nerve is at first

one right.
Vein of the
substance
of the lung.

Pericardial
branches.

Esophageal
branches.

Mediastinal
branches.

Intercostal
arteries.

Number.

Direction to
the inter-
costal
spaces.

Right,
longest.

The anterior
branch

occupies
intercostal
space

with nerve
and vein.

higher than the artery, though it soon takes its place below the vessel.

Offsets. Branches are furnished to the layers of intercostal muscles and the ribs. About the centre (from front to back) of the intercostal space a superficial twig accompanies the cutaneous nerve.

Anastomoses. The upper artery of the set anastomoses with the superior intercostal branch of the subclavian artery; and those below the true ribs enter the abdominal wall, and anastomose with the arteries of that part.

Posterior branch turns to the back. *b.* The posterior branch turns backwards between the vertebra and the ascending costo-transverse ligament, and is distributed in the back. As it passes by the intervertebral foramen it furnishes a small spinal branch to the vertebrae and the spinal cord.—(See VESSELS OF THE SPINAL CORD.)

Intercostal vein. The intercostal vein resembles closely the artery in its course and branching. Near the head of the rib it receives a contributing dorsal branch, and then joins an azygos vein.

Superior intercostal artery from subclavian. The superior intercostal artery of the subclavian trunk is referred to in the dissection of the neck (p. 76). Descending over the neck of the first rib, external to the ganglion of the sympathetic, it supplies a branch to the first intercostal

Supplies one or two spaces. space: continuing to the second space, which it may supply in like manner, it ends by anastomosing with the upper aortic branch. Each intercostal offset from it divides into an anterior and a posterior branch, like the arteries from the aorta.

The vein on the right and on left side. The vein accompanying the right artery opens into the innominate vein. On the left side the superior intercostal vein is formed by branches from the two or three highest spaces; it is joined by the left bronchial vein, and ends in the left innominate vein, after crossing the arch of the aorta.

Two or three azygos veins. The PREVERTEBRAL OR AZYGOS VEINS are two in number on the left side, and one on the right, and receive branches corresponding with the offsets furnished by the descending part of the thoracic aorta. By means of the larger or right vein the inferior cava communicates with the superior, so that blood may reach the heart from the lower part of the body, or the opposite, if one of the cavæ should be obliterated.

Large azygos is on right side of spine. 1. The larger or right azygos vein begins in the lumbar veins on the right side of the spine, and its origin is described with the vessels of the abdomen. It enters the thorax through the aortic opening of the diaphragm, and ascends on the right side of the thoracic duct, over the intercostal

arteries and the bodies of the vertebræ. Opposite the third intercostal space the vein arches forwards above the root of the right lung, and enters the superior cava as this vessel pierces the pericardium. Its valves are very incomplete, so that the intraspinal and intercostal veins may be injected through it.

Branches.—In this vein are collected the intercostals of the right side below the upper two spaces; some of the intercostals of the left side of the thorax, by means of the left azygos veins; and some œsophageal, mediastinal, and vertebral veins, with the right bronchial vein.

2. The *left lower or smaller azygos vein* (inferior) begins in the abdomen in the lumbar veins of the left side of the vertebral column. Having entered the thorax along with the aorta, or through the crus of the diaphragm, the vein ascends on the left of the aorta as high as the seventh or eighth dorsal vertebra, and then crosses beneath that vessel and the thoracic duct to end in the larger or right vein. It receives the four or five lower intercostal veins of the left side, and some œsophageal and mediastinal veins.

3. Most commonly there is a *left upper azygos vein* (Breschet), which is formed by offsets from the spaces between the superior intercostal vein and the highest branch of the left lower azygos. Receiving three or four branches, the trunk either joins the lower azygos of its own side, or crosses the spine to open separately into the right vein.

The ŒSOPHAGUS is a hollow muscular tube which extends from the pharynx to the stomach. The cervical part of the tube has been described at page 128, and the thoracic part is now to be examined.

Entering the thorax rather to the left of the middle line, the gullet is directed inwards beneath the arch of the aorta, and reaches the middle of the spine about the fourth or fifth dorsal vertebra. From that spot it is continued through the greater part of the interpleural space on the right of the aorta, and superficial to the other contiguous bodies; but at the lower part of the thorax it is again inclined to the left, over the aorta, to gain the œsophageal opening of the diaphragm.

As far as the arch of the aorta the œsophagus lies beneath the trachea, though it is inclined somewhat to the left of the air tube; but beyond the arch it is crossed by the left bronchus, and is concealed by the pericardium down to the diaphragm. In this extent the tube is covered on the sides by the pleuræ, and lies on the right of the aorta below

and joins
superior
cava.

Branches
joining it.

Small, or
left lower.
begins in
abdomen,

ends in
larger
azygos.

Branches.

Upper left
azygos vein.

Œsophagus
is partly in
neck

and partly
in the
thorax
where it
lies in front
of the spine,

passes
through dia-
phragm.

Parts cover-
ing it,

on the sides,

and beneath it. the arch. At the upper part of the thorax the œsophagus will be found to rest on the longus colli muscle and the vertebræ; but below the arch of the aorta it is separated from the spine by the intercostal vessels; and lastly it lies on the aorta. Below the situation of the bronchus the pneumo-gastric nerves surround the œsophagus with their branches, and above the same spot the thoracic duct will be found on its left.

Three coats are in it. *Structure.*—If a piece of the middle of the gullet be removed and distended with cotton wool, it will be found to consist of a muscular, a fibrous, and a mucous coat.

A muscular coat of. The *muscular coat* is thick and strong, and consists of two layers of fibres; of which the external is longitudinal, and the internal circular in direction, like the muscular tunic of the other parts of the alimentary tube. In the upper third of the œsophagus the fibres are red, and have the striated or voluntary muscular fibres mixed with the involuntary; but below this the striated fibres gradually disappear, the colour becoming paler with their absence, and only involuntary muscular fibres remain.

voluntary and involuntary fibres. External longitudinal. The *external layer* is formed of parallel longitudinal fibres, which form an entire covering, and end below on the stomach. The fibres begin by longitudinal bands opposite the cricoid cartilage (p. 138); and at intervals varying from half an inch to an inch and a half, they are connected with tendinous points ($\frac{1}{30}$ th to $\frac{1}{10}$ th of an inch long, and $\frac{1}{30}$ th wide) like the fibres of the rectus abdominis muscle.

and internal circular fibres. The *internal layer* of circular fibres is continuous above with the fibres of the pharynx; they are more oblique at the middle than at either end of the œsophagus.

Fibrous coat. The *fibrous layer* is between the muscular and mucous coats, and attaches the one to the other loosely.

Mucous coat. The *mucous coat* or lining will be seen on cutting open the tube to be reddish in colour above but pale below, and to have some thickness. It is very loosely connected with the muscular coat, and is thrown into longitudinal folds when the œsophagus is contracted. Lining the interior is a thick layer of scaly epithelium; and the surface is studded with minute papillæ.

Epithelium and papillæ. Some compound glands (œsophageal) are scattered along the tube; and at the lower part of the gullet they form a ring (cardiac glands) close to the stomach.

Some glands. LYMPHATICS OF THE THORAX.—In the thorax are the lymphatic vessels of both the wall and the viscera, which

In the thorax, lymphatic

enter collections of glands in certain positions, and end in one or the other of the two lymphatic ducts. Besides these, the large thoracic duct traverses the thorax in its course from the abdomen to the neck.

Lymphatic glands.—Along the course of the internal mammary artery is a chain of *sternal* or *mediastinal* glands, which receive lymphatics from the front of the chest, the thymus gland, the pericardium, and the upper surfaces of the diaphragm and liver. On each side of the spine, near the heads of the ribs as well as between the intercostal muscles, is a set of *intercostal* glands for the reception of the lymphatics of the posterior wall of the thorax. At the division and along the side of the trachea are numerous *bronchial* glands, through which the lymphatics of the lung pass. And beneath the arch of the aorta are a few *cardiac* glands, to which the lymphatics of the heart are directed. Along the side of the aorta and œsophagus is a chain of *œsophageal* glands, which are joined by the lymphatics of the œsophagus, and communicate with those of the lungs.

The *thoracic duct* is the main channel by which the lymphatic and lacteal fluid of the lower half of the body, and of the left side of the upper half of the body, is conveyed into the blood. The duct begins in the abdomen in an enlargement (*chyli receptaculum*), and ends in the left subclavian vein of the neck. It is from eighteen to twenty inches in length, and is contained in the thorax, except at its origin and termination. It has the undermentioned connections :—

Entering the cavity on the right side of the aorta, and through the same opening, the duct ascends on the right of that vessel, between it and the vena azygos as high as the arch. Opposite the second dorsal vertebra it passes beneath the arch of the aorta and the left subclavian artery, and is applied to the left side of the œsophagus, by which it is conducted to the neck. Lastly, at the lower part of the neck the duct arches outwards, as before described (p. 125), to open into the left subclavian vein. In this course the tube is oftentimes divided in two, which unite again, or its divisions may even form a plexus; and near its termination it is generally branched. It is provided with valves at intervals, like a vein, and these are in greatest number at the upper part. Occasionally the duct may be found on the left instead of the right side of the aorta.

Branches.—In the thorax the duct receives the lymphatics of the left half of the wall of the cavity, viz. from

glands and duct.

Several sets of glands, into which the lymphatics are collected.

Thoracic duct

begins in the abdomen and ends in neck.

Connection in the thorax.

May be divided.

Is furnished with valves.

Receives lymphatics.

the sternal and intercostal glands; also the lymphatics of the left lung, of the left side of the heart, and of the trachea and œsophagus.

Right duct The *right lymphatic duct*, though not in the thorax, is formed mainly by the large branches received from the viscera in that cavity. It is a short trunk at the lower part of the neck, about half an inch in length, and opens into the angle of union of the subclavian and jugular veins of the same side (p. 76). Its opening is guarded by valves.

It receives lymphatics of the arm and of the thorax. *Branches.*—Into this trunk the lymphatics of the right upper limb, and of the right side of the head and neck pour their contents. In addition, the lymphatics of the right side of the chest, of the right lung and right side of the heart, and some from the right lobe of the liver, after passing through their respective glands, unite into a few large trunks, which ascend beneath the innominate vein to reach the duct in the neck.

Their structure like the blood-vessels. *Structure of the ducts.*—The wall of these tubes resembles that of the bloodvessels in structure (see p. 126). It has an external stratum of fibrous tissue; an inner coat of elastic fibres covered by epithelium; and a middle coat of circular fibres as in the arteries.

Thoracic cord of the sympathetic nerve *CORD OF THE SYMPATHETIC NERVE.*—The thoracic part of each gangliated cord of the sympathetic nerve lies on the side of the spinal column, and is placed over the heads of the ribs and the intercostal vessels. The ganglia on it are usually twelve, one being opposite each dorsal nerve, but this number varies much. The upper ganglion is the largest; and the last two are rather anterior to the line of the others, being situate on the side of the bodies of the corresponding vertebræ. In the chest the sympathetic nerve is covered by the pleura; and it is continuous above and below with the cord in the neck and the abdomen.

has twelve ganglia, Each ganglion furnishes external branches to communicate with the spinal nerves, and internal branches for the supply of the viscera.

and is covered by pleura. *External or connecting branches.*—Two offsets pass outwards from each ganglion to join a spinal nerve (intercostal). In the branches of communication both spinal and sympathetic nerve fibres are combined; but one consists almost entirely of white, and the other nearly altogether of sympathetic nerve fibres.

Branches to join the spinal nerves The *internal or visceral branches* differ in size and distribution, according as they are derived from the upper or the lower six ganglia.

to supply viscera.

a. The *inner branches* of the *upper six* are very small, and are distributed to the aorta, and the vertebræ with the ligaments. Mr. Swan describes a plexus as formed in front of the spine by the union of the branches of opposite sides. From the third and fourth ganglia offsets enter the posterior pulmonary plexus.

In the upper six ganglia offsets are small.

b. The *inner branches* of the *lower six* ganglia are larger and much whiter than the others, and are united together to form visceral nerves (splanchnic) of the abdomen. These splanchnic nerves are three in number (large, small, and smallest), and pierce the diaphragm to end in the solar and renal plexuses.

In the lower six, large and white, and form three nerves.

1. The *great splanchnic nerve* is a large white cord, which has roots apparently from only four or five ganglia (sixth to the tenth), but its fibres may be traced upwards on the knotted cord as high as the third ganglion. The nerve descends on the bodies of the vertebræ, pierces the fibres of the crus of the diaphragm, and ends in the semilunar ganglion of the abdomen.—(See NERVES OF THE ABDOMEN.)

Great splanchnic.

which ends in semilunar ganglion.

At the lower part of the thorax the nerve may be divided into large bundles; and it may present a ganglion, or more than one on its bundles.

2. The *small splanchnic nerve* is formed by roots from the tenth and eleventh ganglia, or their intervening cord; and in the thorax it communicates sometimes with the great splanchnic nerve. It is transmitted inferiorly through the crus of the diaphragm, and enters the part of the solar plexus by the side of the coeliac artery.

Small splanchnic

joins coeliac plexus.

3. The *smallest splanchnic nerve* begins in the last ganglion, and accompanies the other nerves through the diaphragm. In the abdomen it ends in the renal plexus. When this nerve is absent, its place is taken by a branch of the preceding nerve.

Smallest splanchnic ends in renal plexus.

Parts in the upper aperture of the thorax.—The relative position of the several bodies entering or leaving the thorax by the upper opening may be now observed.

Parts in the upper aperture.

In the middle line lie the trachea and the oesophagus, with the remains of the thymus gland. In front of those parts are the lower ends of the sterno-hyoid and sterno-thyroid muscles with layers of the fascia; and behind the gullet and windpipe is the longus colli muscle. Between the two tubes is the recurrent nerve of the left side.

In middle line.

On each side the bag of the pleura and the apex of the lung project into the neck; and in the interval between the pleura and the trachea and oesophagus, are found the

On each side.

Partly the same on both sides, and partly not.

several vessels and nerves which pass from the thorax to the neck, or in the opposite direction. In front on both sides there are the innominate vein and the phrenic and pneumogastric nerves, but farther back the objects on the two sides are different :—on the right side the innominate artery and the cardiac nerves come next ; but on the left side are the left common carotid artery, the thoracic duct, and the left subclavian artery with the cardiac nerves. Lastly, altogether behind on both sides lie the cord of the sympathetic, the first intercostal nerve, and the superior intercostal artery.

PARIETES OF THE THORAX.

Soft parts bounding the thorax.

Between the ribs, forming part of the wall of the thorax, are the two layers of intercostal muscles, with the intervening nerves and arteries. At the base of the thorax is the diaphragm, which bounds the cavity in this direction.

Intercostal muscles.

INTERCOSTAL MUSCLES.—The anterior part of these muscles has been described with the wall of the thorax in the dissection of the upper limb (p. 273). The posterior part of the same muscles may be now examined from the inner side.

Inner intercostal layer reaches angle of the rib.

The *inner intercostal muscle* is fixed to the inner margin of the ribs bounding the intercostal space. Beginning at the sternum, it reaches backwarks only to the angle of the ribs in the middle spaces, but higher and lower the muscular fibres approach nearer the spine. Where the muscle ceases, a thin fascia is continued to the spine. The inner surface is lined by the pleura, and the opposite surface is in contact with the intercostal nerve and vessels.

Connections.

Infracostal; position,

attachments.

The *infracostal muscles* are small slips of fleshy fibres, which are situate on the inner surface of the ribs, where the internal intercostals cease. Apparently part of the inner intercostals, they arise from the inner surface of one rib, and are attached to the upper border and internal surface of the rib next succeeding. They are uncertain in number, but there may be ten : they are smaller above than below, and the upper and lower may pass over more than one space.

Irregularities.

Outer intercostal layer

extends back to head of the rib.

External intercostal muscle.—Between the posterior border of the internal muscle and the spine, when the fascia and the muscles above referred to have been removed, the external intercostal muscle will be seen. Its borders are fixed to the contiguous margins of two ribs, and its fibres cross the inner intercostal layer. Whilst this muscle extends backwards to

the tubercle of the rib, it does not reach farther forwards than the rib cartilages, as before said (p. 273).

Dissection.—In a few spaces the internal intercostal muscle may be cut through, and the intercostal nerve and artery traced outwards. Trace nerves.

The INTERCOSTAL NERVES are the anterior primary branches of the dorsal nerves. In distribution they differ from the other spinal nerves of the body, inasmuch as they course forwards to the middle line without being united in a plexus. Twelve in number, they occupy the intercostal spaces, and the last is placed below the twelfth rib. The following difference obtains between the upper and the lower nerves : Intercostal nerves are not joined in a plexus.
viz., the upper six lie between the ribs in all their extent, and are confined to the wall of the thorax ; whilst the lower six are prolonged into the abdominal wall where the ribs cease in front. Upper six are in spaces ; lower six leave in front.

At the posterior part of the chest the nerves lie at first between the pleura and the external intercostal muscle, with an artery and vein ; but they enter soon between the two strata of the intercostal muscles, and extend forwards to the middle line of the body. Near the head of the rib each nerve is joined by filaments from the sympathetic. In its course each supplies *branches* to the intercostal muscles of the ribs ; as well as cutaneous offsets to the surface ; these are described in the dissections of the upper limb and wall of the abdomen. Connections with muscles ; with the sympathetic. Offsets.

There are some deviations in the first and second nerves from the general arrangement above specified. Exceptions in first two.

The *first nerve* ascends in front of the neck of the highest rib, and ends in the brachial plexus. Before it leaves the chest it supplies a branch to the first intercostal space ; this extends forwards in the place of the intercostal nerve, furnishing muscular offsets, and becomes cutaneous by the side of the sternum. There is not any lateral cutaneous branch from this nerve, except in those cases in which the next nerve is not as large as usual. First nerve enters brachial plexus. Has not lateral cutaneous branch.

The *second nerve* may extend a considerable way on the wall of the chest before entering between the intercostal muscles, and may ascend even to the first space. It is remarkable in having a very large lateral cutaneous branch (p. 259). In front it ends like the others. Second nerve.

Upper surface of the diaphragm.—The anatomy of the diaphragm will be described specially with the deep muscles of the abdomen ; and the arch of the muscle towards the thorax has been referred to before (p. 352). Upper surface of diaphragm.

Parts in
contact
with it.

Apertures
in it.

The dissec-
tion of the
back is now
made.

The centre of the muscle is tendinous, and the sides are fleshy. In contact with the upper surface are the lungs on the sides, and the pericardium in the middle. In the diaphragm are the following apertures :—one for the cesophagus and the pneumogastric nerves, another for the vena cava, and a third for the aorta with the thoracic duct and the vena azygos. The phrenic vessels and nerves enter the upper surface, external to the pericardium ; and the splanchnic nerves are transmitted to the abdomen through the posterior part, whilst the sympathetic passes beneath it.

Directions.—The dissector of the thorax now waits while the dissection of the back is made. Afterwards he is to examine the ligaments of the ribs and spine : a notice of these will be found in the following section.

SECTION II.

LIGAMENTS OF THE TRUNK.

Enumera-
tion of the
ligaments.

A rib is
united with
the verte-
bræ and the
sternum.

To see liga-
ments to
the verte-
bræ.

To rib and
sternum.

Ligaments
of head of
rib are

The ligaments of the vertebræ, of the ribs, and of the sternum, are described in this section.

ARTICULATION OF THE RIBS.—Each sternal rib is united to the vertebræ on the one side, and to the sternum on the other, by three sets of ligaments, viz., one between the head of the bone and the bodies of the vertebræ ; a second from the neck and tubercle to the transverse processes of the vertebræ ; and a third between the cartilage and the sternum. The asternal ribs will want the last articulation.

Dissection.—For the purpose of examining the ligaments between the head and neck of the rib and the vertebræ, take a piece of the spinal column with three or four ribs attached. After removing the intercostal muscles and the loose tissue from the surface of the bones, the student will be able to define the following undermentioned ligaments passing from the head and neck of the rib to the spinal column and the transverse processes.

The ligaments attaching the costal cartilage to the rib and sternum are to be dissected on the part of the anterior wall of the thorax that was removed in opening the thoracic cavity.

A. Ligaments from the head of the rib.—The head of the rib is received into a hollow on the side of the bodies of two contiguous vertebræ, except in the first, eleventh, and twelfth

ribs; and the articulation is provided with two retaining ligaments—costo-vertebral and interarticular, and two synovial sacs.

The *costo-vertebral ligament*, which is also named *stellate* costo-vertebral or stellate, from its form (fig. 58, ³), is composed of radiating fibres.

Fig. 58.*



Where the ribs touch two vertebrae it consists of three sets of fibres:—The upper set, the largest, ascends to the body of the vertebra above the head of the rib; the lower set descends to the vertebra below the head; and the central part is united with the fibro-cartilage between the vertebrae.

Where the rib is in contact with the body of only one vertebra, as in the first, eleventh, and twelfth, the ligament has but two sets of fibres. The chief fibres are fixed into the vertebra; whilst an ascending band is attached to the body of the vertebra immediately above, and that from the first rib is continued to the last cervical vertebra. differs in certain vertebrae.

The *interarticular ligament* will be seen when the stellate Inter-articular, ligament is divided. It is a short thin band of fibro-car-

* Ligaments of the ribs and vertebrae (Bourguery).—1. Anterior ligament of the bodies of the vertebrae. 2. Lateral part of the anterior ligament of the spine. 3. Ligament (stellate) between the vertebrae and head of the rib. 4. Ascending costo-transverse ligament. 5. Interspinous ligament.

tilage, which is attached on one side to the ridge separating the articular surfaces on the head of the rib, and on the other to the fibro-cartilaginous substance between the vertebræ. In the first, eleventh, and twelfth ribs it is absent.

with two
synovial
sacs.

Synovial sacs.—There are two sacs in the articulation, one on each side of the interarticular ligament, except in the three ribs before mentioned, where there is but one.

Ligaments
of neck of
rib,

B. *Ligaments from the neck and tubercle of the rib.*—Three ligaments (costo-transverse) pass from the neck and tubercle of the rib to the transverse processes. And there is one synovial sac between the rib and its transverse process.

anterior
costo-trans-
verse.

The *anterior costo-transverse* ligament (fig. 58, ⁴) is larger and longer than the others. It ascends from the upper border of the neck of the rib to the lower edge of the transverse process of the upper of the two vertebræ with which the head of the rib is connected: it is wanting in the first rib. Between this ligament and the vertebræ the posterior branches of the intercostal artery and dorsal nerve pass backwards; and by the outer edge it is continuous with the fibrous membrane between the strata of the intercostal muscles.

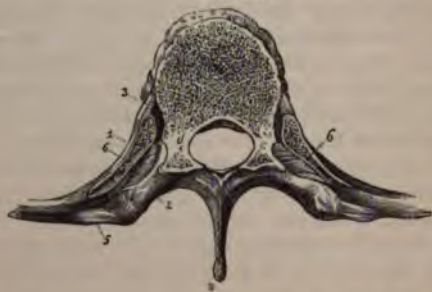
Posterior
costo-trans-
verse.

The *posterior costo-transverse* (fig. 65, ³) is placed at the posterior aspect of the rib. It is a short band of fibres between the tip of the transverse process and the rough part of the tubercle of the rib. This band is longest on the lowest two ribs.

Middle

The *middle or interosseous costo-transverse* is placed hori-

Fig. 59.*



costo-trans-
verse.

zontally between the neck of the rib and the transverse process with which the tubercle articulates (fig. 59, ⁶). It

* The body of a dorsal vertebra and the inner end of a rib sawn through horizontally, to show the uniting ligaments.—1. The sawn rib.

will be best seen by sawing horizontally through the rib and the transverse process. Its fibres are mixed with reddish areolar tissue.

If the posterior ligament is divided, a *synovial membrane* will be found in the joint between the tubercle of the rib and the transverse process (fig. 65). In the lowest two ribs which do not touch the transverse processes, the *synovial sac* is absent.

Synovial
sac,

where
absent.

C. *Ligaments from the cartilages of the ribs.*—The costal cartilages of the true ribs are united to the sternum by a fibrous capsule, which covers a synovial membrane; and they are further joined externally to the bony part of the rib. Some of the lower cartilages touch each other and are connected together by fibrous bands and synovial membrane.

Union of the
costal
cartilages.

In the *chondro-sternal articulation* (fig. 29, ⁶), the cartilages of the true ribs are received into the depressions on the side of the sternum, and are fixed in their position by surrounding fibres forming a capsule. In front and behind the capsule are thickened bands, which have been described as an *anterior* and a *posterior ligament*. Between the cartilage and the articular surface of the bone is a *synovial membrane*.

Cartilages
with the
sternum.

In the joint of the second cartilage there is an inter-articular ligament, as to the head of the rib, which joins the cartilage between the pieces of the sternum. A synovial sac exists on each side of the interarticular ligament.

Second car-
tilage has a
double joint.

A separate band of fibres passes between the cartilage of the seventh rib and the xiphoid cartilage, and is named *costo-xiphoid ligament*.

Costo-
xiphoid
ligament.

Costal cartilage with the rib.—The bony part of the rib is hollowed to receive the costal cartilage, and the only investing membrane between the two is the periosteum of the rib.

Costal
cartilage
with rib.

One costal cartilage to another.—The contiguous surfaces of the costal cartilages from the sixth to the ninth are connected by ligamentous fibres; and the articulations are provided with synovial membranes.

Cartilages
with one
another.

ARTICULATION OF THE PIECES OF THE STERNUM.—The upper piece of the sternum is connected to the lower by an intervening piece of cartilage, and by anterior and posterior longitudinal fibres.

Union of
pieces of
sternum.

ARTICULATION OF THE VERTEBRÆ.—The several vertebræ

Two sets of

2. The transverse process. 3. The stellate or costo-vertebral ligament.
5. Posterior costo-transverse ligament. 6. Middle costo-transverse or interosseous ligament.

ligaments
unite the
vertebræ.

composing the spinal column are united together by two sets of ligaments—one between the bodies and the other between the processes of the bones.

These ligaments have a general resemblance along the spinal column, and one description will suffice for all except for those between the first two vertebræ and the head, and between the bones of the pelvis. The description of the special ligaments will be found in the dissections of the neck and pelvis.

How to see
the several
ligaments.

Dissection.—After the ligaments of the ribs have been examined, the same piece of the spinal column will serve for the ligaments of the bodies and articular processes of the vertebræ. It is supposed that the spinal canal has been opened to examine the spinal cord, and that the posterior ligament of the bodies of the vertebræ is therefore laid bare; but if the canal should not be open, the arches of the vertebræ must be sawn through close to the articular processes. The anterior ligament of the bodies will be prepared with very little trouble, by removing the areolar tissue.

The remaining ligaments between the neural arches and the spines of the bones may be defined on the pieces taken away in opening the spinal canal.

The bodies
are united
by:

A. *Ligaments of the bodies of the vertebræ.*—The bodies of the moveable vertebræ, except the first and second, are united by an anterior and a posterior common ligament, and by intervening pieces of fibro-cartilage.

Anterior
common
ligament,
varies in
width,

The *anterior common ligament* (fig. 58, ¹) is white and strong, and reaches from the atlas to the sacrum; it is widest opposite the lumbar vertebræ, and becomes narrower as it is traced upwards. Its fibres are longitudinal in direction, and consist of a superficial and a deep layer: by detaching parts of the ligament, the superficial fibres will be seen to reach the length of three or more vertebræ, whilst the deep reach from bone to bone. A greater number of the fibres are attached to the intervertebral fibro-cartilages than to the bones; and more are fixed to the margins than to the centre of the body of each vertebra. Its outline is uneven, for it is broader over the bodies of the vertebræ (²), than on the intervertebral substance; and if the ligament be cut across at intervals it will be found to be thickest opposite the hollow part of the body of each vertebra.

length,

attach-
ment of its
fibres,

and in
thickness.

Posterior
common
ligament is
wide at
parts;

The *posterior common ligament* (fig. 60,) is contained in the spinal canal, lying on the posterior surface of the bodies of the vertebræ, and extends from the sacrum to the occipital bone. This ligament is wide above, and diminishes in size

downwards, just the opposite of the anterior. In the neck it is loose, and extends all across the bodies of the vertebræ, whilst in the loins it is only a thin narrow band. Opposite the dorsal and lumbar intervertebral substance it is wider than at the bodies of the vertebræ; and it sends off on each side a pointed process to be attached to the pedicle of the neural arch; so that the margins are zigzag or dentate in those regions of the spine. Its fibres are superficial and deep as in the anterior ligament, and are more closely united with the intervertebral substance than with the bone. One surface of the ligament is in contact with the dura mater; and between the opposite surface and the vertebræ are large intraspinal veins.

Fig. 60.*



attachment
and
connections.

Dissection.—To see the intervertebral substance, the anterior and posterior common ligaments must be taken away. One vertebra should be detached from the intervening fibro-cartilage to obtain a horizontal view of this structure; and two other vertebræ should be sawn vertically to see the difference in the consistence, and the arrangement of the laminae.

To see the
inter-
vertebral
substance.

The *intervertebral substance* (fig. 61, †) is placed between Inter-

Fig. 61.†



the contiguous surfaces of the bodies of the vertebræ, from the axis to the sacrum. Its width is determined by the vertebral substance

* Lumbar vertebræ, with the posterior common ligament of the bodies.

† Intervertebral substance of the lumbar region.—1. A superficial lamina. 2. A deeper layer. The difference in the direction of the fibres of the layers is seen.

vertebræ, and it forms an almost circular disc between the bones. It is connected in front and behind with the anterior and posterior common ligaments, and on the sides with the stellate ligaments of the heads of the ribs. These masses are thicker between the lumbar and cervical, than between the upper dorsal vertebræ; and where the spinal column is arched forwards, as in the loins and neck, they are deepest at the anterior edge.

By means of the dissections before made, the intervertebral substance may be observed to consist of two distinct parts; an external, firm and laminar, and an internal, soft and elastic (fig. 63).

The outer laminar part (fig. 63, ¹) forms more than half of the disc, and is composed of a series of pieces of fibro-cartilage, alternating with layers of fibrous tissue. All the strata are arranged one within another, like the scales of an onion, and are connected by their edges to the bodies of the

Fig. 62.*



vertebræ; but all have not a vertical position, for the outer pieces are bent, so that their convexity is towards the surface (fig. 62, ¹), and the inner are convex towards the centre of the disc (²). The laminæ of the fibro-cartilage form complete rings less frequently than the layers of fibrous tissue. Each layer is constructed of oblique fibres; and the fibres of one layer are directed across those of another like the parts of the letter X (fig. 61). This disposition of the fibres will be best seen on the discs between the lumbar vertebræ; and it may be rendered evident by dissecting layer after layer.

* Vertical section of the intervertebral substance, showing the bent condition of the external layers.—1. Layers bent outwardly. 2. Layers bent inwardly. 3. Central pulpy substance.

The central portion of the disc (fig. 63, ²) is very soft and elastic, and projects when two vertebræ and the interposed mass are sawn through. It has a yellowish colour, and is

Inner part without marked strata ;

Fig. 63.*



deficient in the stratiform arrangement so conspicuous at the circumference. Towards the confines of the two portions of the intervertebral substance, there is still an alternating arrangement of fibrous tissue and fibro-cartilage, though the former is gradually diminishing ; but towards the centre a loose fibro-cartilaginous material preponderates, and amongst it are spaces containing fluid.

is fibro-cartilaginous.

The surfaces of the vertebræ in contact with the discs, have a cartilaginous covering. This may be seen by cutting the intervertebral substance from the bone. Over the centre of each osseous surface it forms a continuous layer, but towards the circumference it consists of separate pieces.

Cartilage covering bones.

B. *Ligaments of the processes of the vertebræ.*—The several processes of the vertebræ have special uniting ligaments :—thus the articular processes are joined by a capsule and a synovial membrane ; the neural arches are connected by yellow ligaments ; the spinous processes have one band along the tip and another between their borders ; and the transverse processes are provided with intervening bands of fibres.

Several ligaments of the vertebral processes.

Ligaments of the articular processes.—Between the articulating processes there is a moveable joint (fig. 24, ⁴). The bones are covered with cartilage, and are surrounded by a loose capsular ligament of scattered fibres enclosing a synovial membrane. In the cervical part of the spine the cap-

To the articular, are capsule and sac.

* A horizontal cut through an intervertebral fibro-cartilage.—1. Laminar external part. 2. Pulpy central part of the fibro-cartilage.

sular ligaments are larger and looser than in the dorsal or lumbar region.

Those of the arches are two to each space. *Ligaments of the arches.*—The *ligamenta subflava* (fig. 64,²), so named from their colour, are situate between the neural

Fig. 64.*



Attach-
ments.

arches of the vertebræ, and close the spinal canal behind. In the interval between the arches of two contiguous vertebræ are two somewhat square ligaments, one for each half of the arch, which approach one another along the middle line. Each consists of elastic yellow tissue, and is attached above to the inner surface of the one arch, but below to the upper border, and somewhat to the outer surface of the other neural arch. On each side the ligament reaches from the articular process to the root of the spinous process. Between the first two vertebræ and the skull there are special fibrous ligaments in the corresponding situation (see p. 184).

Those of the
spines are
along their
tip.

Ligaments of the spines.—Along the tips of the spinous processes of the dorsal and lumbar vertebræ is a longitudinal band of fibres (fig. 65,¹),—the *supraspinous* ligament. It is thicker in the lumbar than in the dorsal region of the spine, and is formed by superficial and deep fibres; the former reaches over three or more spines, whilst the latter pass from bone to bone. It is closely united with the tendons

* An inner view of the neural arches of the vertebræ, with their interposed ligaments.—1. and 2. Ligamenta subflava. (Bourguery and Jacob.)

of the muscles. The band called *ligamentum nuchæ*, which is composed of fibrous tissue, takes its place in the neck.

Along the spinal column there are also thin and somewhat membranous *interspinous* ligaments (fig. 58, ^s), which reach and be-
tween them.

Fig. 65.*



from the root to the tip of the spinous processes. The strength of these bands is dependent upon the interval they have to fill ; they are more marked in the lumbar than in the other vertebræ, and they are least strong in the cervical region.

Ligaments of the transverse processes.—In the loins the *intertransverse ligaments* are thin membranous bands in the intervals between the processes. In the dorsal vertebræ they are round bundles of fibres (fig. 65, ^t). And in the neck the fibres exist only at the apex of the processes, or they may be wanting here and there.

Those of the
transverse
processes.

* Ligaments of the processes of the vertebræ, and of the ribs. (Bourguery).—1. Supraspinous band of ligament. 2. Ligamentum subflavum. 3. Posterior costo-transverse ligament: on the opposite side the band has been removed and the joint opened. 4. Intertransverse ligament.

CHAPTER V.

DISSECTION OF THE BACK.

How the
dissection
is to be
conducted.

Directions.—According to the mode of dividing the body, the dissection of the back may be allotted to one student; or it may be undertaken conjointly by the dissectors of the head and upper limbs,—the former preparing the neck, and the latter making ready the parts in the dorsal and lumbar regions.

If the back should belong to more than one student, the dissector of the upper limb may attend chiefly to the paragraphs marked with an *asterisk*; and the dissector of the neck may study specially the paragraphs which are not so marked. But as many of the dissections, especially in the earlier stages, require the co-operation of the students employed on the same side of the body, a general attention should be given to the whole by each student.

The dissector of the abdomen is to examine the arrangement of the fascia lumborum, after the first layer of muscles has been learnt.

Position of
body.

Position.—For this dissection the body lies with the face downwards; and the trunk is to be raised by blocks beneath the chest and the pelvis, so that the limbs may hang over the end and sides of the dissecting table. To make tense the neck, the head is to be depressed and fastened with hooks.

Dissection

Dissection.—In the back the student will meet with successive strata of large muscles, five in all, amongst which vessels and nerves are interspersed.

to raise the
skin.

The first step in the dissection is to raise the skin from the surface on each side in two flaps, by means of the following incisions:—One cut is to be made along the middle line of the body from the occipital protuberance to the back of the sacrum. Another incision is to be carried from the last dorsal vertebra to the acromion process of the scapula. The flap of skin above the last cut is to be turned outwards

by the dissectors of the head and upper limb. The remaining piece of integument is to be detached by a transverse incision opposite the iliac crest, and to be reflected by the dissector of the upper limb in the same direction as the other flap. Under the upper flap of skin is the trapezius, and underneath the lower one is the latissimus dorsi muscle.

The cutaneous nerves may be now sought in the superficial fatty layer. Small cutaneous arteries accompany the nerves, and guide the student to their position. These nerves vary much in size in the different parts of the back, and their number is also irregular: as a general rule, there is one over each vertebra. In the neck, and opposite the upper part of the thorax, the nerves will be found near the spines of the vertebræ, and beneath the superficial layer of fat; but at the lower part of the thorax, and in the loins, they issue in a line with the angles of the ribs.

The cutaneous branches of the sacral nerves come into the dissection of the lower limb.

CUTANEOUS NERVES.—The tegumentary nerves of the back are derived from the posterior primary branches of the spinal nerves. At first these subdivide amongst the deep parts into two branches, inner and outer, from which the cutaneous offsets are derived,—at one spot from the external, and at another from the internal branch. Small arteries accompany the greater number of the nerves; they bifurcate like the nerves, and the cutaneous offsets are derived from the one or the other branch.

Cervical nerves.—In the neck the nerves are derived from the inner of the two pieces into which the primary branches bifurcate: they perforate the trapezius, and supply the neck and the back of the head. They are four in number, viz., one from each nerve, except the first and the three last.

The branch of the *second nerve* is named large occipital, and accompanies the occipital artery to the back of the head (p. 8).

The branch of the *third cervical nerve* supplies a transverse offset to the neck, and then bends upwards to the lower part of the head, where it is united with the great occipital nerve, and is distributed nearer the middle line.

* *Dorsal nerves.*—These are obtained from both the inner and the outer offsets of the primary branches—the upper six from the inner, and the lower six from the outer. On the surface they are directed outwards in the integument over the trapezius and latissimus dorsi muscles.

Seek cutaneous nerves.

Cutaneous nerves how derived.

In the neck. Source.

Second

and third nerve.

In the dorsal region.

Upper six. The *upper six* nerves perforate the trapezius near the spines of the vertebræ; and the branch of the second, which is larger than the rest, reaches as far as the scapula. The lower six. *lower six* nerves pierce the latissimus dorsi mostly in a line with the angles of the ribs; they are oftentimes uncertain in number.

In the loins. * *Lumbar nerves*.—In the loins the nerves are derived from the outer parts of the primary branches, and only from the first three; they perforate the latissimus dorsi muscle in a line with the outer border of the erector spinæ, and crossing the iliac crest of the innominate bone, are distributed in the integuments of the buttock.

Dissection. *Dissection*.—The superficial fascia is to be taken from the trapezius and latissimus dorsi in the direction of the fibres of each, viz., from the shoulder to the spinal column; and the upper limb is to be carried backwards or forwards according as it may be necessary to put on the stretch the different portions of the muscles. Some of the cutaneous nerves may be left, in order that they may be traced afterwards through the muscles to their origin.

Two muscles in first layer. * *FIRST LAYER OF MUSCLES*.—Two muscles, the trapezius and the latissimus dorsi, are included in this layer.

Trapezius. * *THE TRAPEZIUS MUSCLE* (fig. 66,¹) is triangular in shape, with the base towards the spine, but the two muscles have a trapezoid form. The muscle has an extensive aponeurotic origin along the middle line, from the head to the loins, viz. from the spines of the dorsal vertebræ and their supraspinous ligament; from the spinous process of the seventh cervical vertebra; from the ligamentum nuchæ between the last point and the head; and lastly from the inner third of the superior transverse ridge of the occipital bone. From this origin the fibres are directed outwards, converging to the shoulder, and are *inserted* into the outer third of the clavicle, at its posterior aspect; into the posterior or upper border of the acromion; and into the upper edge of the spine of the scapula as far as to an inch of the root of that process, as well as into a rough impression on the surface of the spine near the hinder part.

Insertion chiefly fleshy. The muscle is subcutaneous. At the outer side the lowest fleshy fibres end in a small triangular tendon, which glides over the smooth surface at the root of the spine of the scapula. The anterior border bounds behind the posterior triangular space of the side of the neck. By its insertion the trapezius corresponds with the origin of the deltoid muscle.

Connections.

Dissection.—The fibres of the trapezius are to be divided near the scapula, and over the spinal accessory nerve, so that the ramifications of the nerve in the muscle, and its

Trace spinal accessory.

Fig. 66.*



junction with the branches of the cervical plexus may be traced. A small artery to the trapezius (art. superficialis colli) accompanies the nerve.

* Muscles of the back, with some muscles of the scapula : on the left side are the superficial muscles of the back, and on the right some deeper muscles.

Left side.—1. Trapezius. 2. Latissimus-dorsi. 17. External oblique of the abdomen.

Right side.—3. Rhomboideus minor. 4. Rhomboideus major. 5. Levator anguli scapulae. 6. Serratus posticus inferior. 7. A part of the erector spinae. 8. Splenius capitis. 9. Complexus. 10. Serratus magnus.

Shoulder muscles—11. Deltoid. 12. Supra-spinatus. 13. Infra-spinatus. 14. Teres minor. 15. Teres major. 16. Long head of the triceps.

Spinal
accessory
nerve in
trapezius.

The *spinal accessory nerve*, one of the trunks of the eight pair of cranial nerves (p. 119), having crossed the posterior triangle of the neck, enters beneath the trapezius, and forms a plexiform arrangement with branches of the third and fourth nerves of the cervical plexus. The nerve is distributed to the muscle, and its filaments reach nearly to the lower border.

Dissection
to reflect
trapezius;

Dissection.—To see the parts covered by the trapezius, this muscle is to be divided longitudinally, internal to the position of the spinal accessory nerve, and its pieces are to be thrown inwards and outwards.

to prepare
parts in the
neck;

The dissector of the neck should define the parts beneath the clavicle, viz., the posterior belly of the omo-hyoid muscle with the suprascapular nerve and artery; the transverse cervical vessels; and the small branches of nerves to the levator anguli scapulæ, and the rhomboid muscles. If the trapezius be detached along the middle line, the ligamentum nuchæ, from which it takes origin, will be brought into view.

clean the
scapular
muscles.

* The dissector of the upper limb should clean the fibres of the rhomboidei and levator anguli scapulæ muscles, which are fixed to the base of the scapula; and whilst this is being done, the scapula is to be drawn away from the trunk to make tense the fibres.

Parts
covered by
trapezius.

* *Parts covered by the trapezius.*—The trapezius conceals in the neck the splenius and a small part of the complexus, with the levator anguli scapulæ; and in the dorsal region it covers the following muscles,—the rhomboidei, the erector spinæ, and the latissimus dorsi. Near the scapula it lies over the supraspinatus muscle.

Ligamen-
tum nuchæ.

The *ligamentum nuchæ* is a narrow fibrous band, which extends from the spinous process of the seventh cervical vertebra to the occipital protuberance. This structure serves as a partition between the muscles of opposite sides of the neck; and from the under part processes are sent down to be attached to the spines of the six lower cervical vertebræ. In man it is not formed of elastic tissue.

Latissimus
dorsi is
named from
its width.
Origin is
tendinous
except from
some ribs.

* The *LATISSIMUS DORSI* is thin, and is the widest muscle in the back (fig. 66, 2); it is pointed and fleshy towards the humerus, but aponeurotic at its inner attachment or origin. It arises along the middle line from the spinous processes of the six lower dorsal, from the spines of all the lumbar and the upper two sacral vertebræ, as well as from the supraspinous ligament. Along the outer side it arises by an aponeurosis from the outer edge of the posterior half of the

iliac crest; and by three or four fleshy processes from as many of the lower ribs, which digitate with pieces of the external oblique muscle of the abdomen. And between the outer and inner attachments it is inseparably blended below with the subjacent tendon of the multifidus spinæ. All the fibres converge to the inferior angle of the scapula, and after crossing that point of bone are continued forwards to be *inserted*, by means of a tendon, into the bottom of the bicipital groove of the humerus (p. 271).

Insertion
into
humerus.

The muscle is subcutaneous, except a small part of the upper border which is covered by the trapezius; near the scapula there is a space between the two muscles, in which the ribs and the intercostal and rhomboid muscles are seen. The lower or anterior border overlays the edge of the external oblique abdominal muscle in the interval between the last rib and the iliac crest, except a small part below. Frequently the latissimus has a distinct fleshy slip from the inferior angle of the scapula.

Conne-
ctions.

* *Dissection.*—The latissimus is to be divided about midway between the spines of the vertebræ and the angle of the scapula, and the pieces are to be reflected inwards and outwards. In raising the inner part of the muscle, care must be taken not to destroy the thin lower serratus with which it is united, and the aponeurosis continued upwards from the serratus. In the interval between the last rib and the iliac crest the latissimus is adherent to the aponeurosis of the transversalis abdominis muscle, and should not be detached from it.

Dissection
to reflect
latissimus.

* *Parts covered by the latissimus.*—The latissimus dorsi muscle lies on the erector spinæ, on the serratus posticus inferior, and on the lower ribs with their intercostal muscles. As it rests on the angle of the scapula, it conceals the teres major, and a part of the rhomboid muscle. Its relation to the teres is worthy of note:—at the angle of the scapula it is in contact with the posterior surface of the teres, but nearer the humerus it turns round, and is inserted in front of that muscle. Between the angle of the scapula and the humerus the latissimus forms part of the posterior boundary of the axilla.

Parts
covered
by the
latissimus.

Forms
axillary
wall.

Dissection.—After the latissimus dorsi has been reflected, the dissector of the abdomen can look to the disposition of the posterior tendon of the transversalis abdominis (fascia lumborum) between the last rib and the innominate bone.

Dissection
of fascia
lumborum;

In the spot referred to are portions of the muscles left in the dissection of the wall of the abdomen. Firstly, a piece

of the external oblique muscle may, or may not remain. After the removal of this muscle (supposing a part to be left), the internal oblique will be seen to be attached to a subjacent aponeurosis, and to the ribs and the iliac crest; its attachments above and below are to be cut through, and it is to be raised from the transversalis muscle towards the spine, as far as possible without detaching it. Then the aponeurosis of the transversalis muscle (*fascia lumborum*) appears, and perforating it are two nerves:—one, the last dorsal with an artery near the last rib; and the other, the ilio-hypogastric, close to the iliac crest.

of processes
from it.

Two offsets are prolonged backwards from this fascia to the transverse processes. To see one prolongation, viz., the one that is attached to the apices of the processes, the *latissimus dorsi* is to be cut through (both its aponeurosis and fleshy part) by an incision directed outwards from the middle line, on a level with the spinous process of the third lumbar vertebra; on raising the outer border of the muscle (*erector spinæ*) which comes into view, the strong process of the fascia will be apparent. After dividing transversely this first prolongation, another muscle (*quadratus lumborum*) will be seen; and on raising its outer border the second thin offset of the fascia will be evident on the abdominal aspect of the muscle.

Fascia
lumborum
is part of
trans-
versalis
abdominis;

The *fascia lumborum* is the posterior aponeurosis or tendon of the transversalis abdominis muscle, and occupies the interval between the last two ribs and the crest of the hipbone. By its cutaneous surface it gives attachment to the internal oblique muscle, sometimes to the external oblique, and to the aponeurosis of the *latissimus dorsi* and *serratus posticus inferior*. The last dorsal and ilio-hypogastric nerves pierce it in their course from the abdomen.

has two off-
sets behind,

From the inner part of the aponeurosis two prolongations reach the transverse processes of the lumbar vertebræ, and enclose the *quadratus lumborum*. The more superficial of the two is the strongest; it lies beneath the *erector spinæ* in this position of the body, and is connected to the apices of the transverse processes, but it also fills the intervals between those osseous pieces. The deeper or anterior prolongation passes on the abdominal surface of the *quadratus lumborum*, and is fixed to the roots of the transverse processes, and the bodies of the vertebræ. Thus the prolongations of the fascia contain the *quadratus lumborum* in a sheath.

one to apex,

the other to
root of the
transverse
processes;

which form

In like manner the *erector spinæ* lies in another sheath,

which is formed by the vertebral aponeurosis and the tendons of the latissimus and serratus on the one side, and by the posterior of the two prolongations of the fascia lumborum on the other.

* **SECOND LAYER OF MUSCLES.**—This stratum contains the elevator of the angle of the scapula, and the large and small rhomboid muscles. Besides these, there will be found in the neck the posterior belly of the omo-hyoid muscle, with some vessels and nerves that turn backwards towards the scapula.

* The *LEVATOR ANGULI SCAPULÆ* (fig. 66, ¹) arises by tendinous slips from the tips of the posterior transverse processes (diapophyses) of the upper three or four cervical vertebrae. The fibres form rather a roundish muscle, and are inserted into the base of the scapula between the spine and the superior angle. At its origin the muscle is beneath the sterno-mastoideus, and at the insertion it lies beneath the trapezius; the rest of the muscle appears in the posterior triangular space of the neck. Beneath it are some of the other cervical muscles, viz., splenius colli and cervicalis ascendens.

* **RHOMBOIDEI MUSCLES.**—The thin muscular layer of the rhomboidei is attached to the base of the scapula, and consists of two pieces, large and small, separated by a slight interval.

* The *rhomboides minor* (fig. 66, ²) is a small narrow band, which arises from the spinous processes of the seventh cervical and first dorsal vertebrae, and from the ligamentum nuchæ; it is inserted into the base of the scapula, opposite the smooth surface at the root of the spine.

* The *rhomboides major* (fig. 66, ³) is larger than the preceding by the width of three or more spinous processes. It arises from the spines of the upper four or five dorsal vertebrae below the rhomboides minor, and from the supra-spinous ligament; and its fibres are directed outwards to be fixed to the base of the scapula between the spine and the lower angle. Sometimes all the fibres do not reach directly the scapula, but some end on a tendinous arch near the bone.

The rhomboidei muscles are covered chiefly by the trapezius and the latissimus, but a portion of the larger rhomboid muscle is subcutaneous near the angle of the scapula.

The *OMO-HYOID MUSCLE* consists of two fleshy bellies, anterior and posterior, which are united by an intervening tendon (p. 67). Only the posterior half is now seen (fig.

sheaths for muscles.

Second muscular layer.

Elevator of angle of scapula.

Attachments and connections.

Rhomboid muscles are two.

Small muscle.

Attachments.

Large muscle. Origin.

Insertion.

Connections.

Posterior belly of omo-hyoides.

- Origin 8, ⁵). The muscle *arises* from the upper border of the scapula, behind the notch, and from the ligament that converts the notch into a foramen. The fibres form a thin riband-like muscle, which is directed forwards across the lower part of the neck, and ends anteriorly in a tendon beneath the sterno-mastoideus. The fleshy belly of the muscle is placed partly beneath the trapezius; and is partly superficial in the posterior triangular space of the neck, where it lies above the clavicle and the subclavian artery. It lies on the brachial plexus, and on the suprascapular vessels and nerve near the scapula.
- and termination. The *suprascapular artery* is a branch of the subclavian trunk (p. 74), and is directed almost horizontally outwards across the lower part of the neck to the back of the scapula. The vessel lies behind the clavicle, and courses along that bone with the suprascapular nerve, but beneath the trapezius and omo-hyoid muscles, to the supraspinal fossa of the scapula. Before entering the fossa it furnishes a small branch (supra-acromial) to the upper surface of the acromion.
- Connections. The *suprascapular nerve* is an offset of the brachial plexus (p. 78), and is inclined backwards to the superior costa of the scapula. It passes through the notch in the upper costa of the bone, and beneath the supraspinatus muscle; its termination in the muscles on the dorsum of the scapula will be seen in the dissection of the arm (p. 284).
- Supra-scapular artery of the subclavian ends on back of scapula. The *transverse cervical artery* is also a branch of the subclavian, and has the same direction as the suprascapular branch, viz., towards the upper part of the scapula, but it is placed at a greater height above the clavicle. Crossing the upper part of the space in which the subclavian artery lies, this branch passes beneath the trapezius, and divides into the two following branches—superficial cervical and posterior scapular :—
- Supra-scapular nerve accom-panies artery. *a.* The *superficial cervical branch* is distributed chiefly to the under surface of the trapezius, though it furnishes offsets to the levator anguli scapulae and the cervical glands.
- Transverse cervical artery of the subclavian divides into superficial cervical and posterior scapular. *b.* The *posterior scapular branch* crosses beneath the elevator of the angle of the scapula, and turns downwards along the base of the scapula beneath the rhomboid muscles. If the rhomboid muscles are divided, the artery will be seen to furnish branches to them; and to give anastomotic twigs to both surfaces of the scapula, which join the other arteries distributed on the bone.
- This branch arises very frequently as a separate artery from the third part of the subclavian trunk.

The veins have the same names and course as the arteries above described; they open into the external jugular vein near its junction with the subclavian vein. Accompanying veins.

Nerve to the rhomboid muscles.—This slender nerve of the brachial plexus (p. 77) takes the course of the preceding artery beneath the elevator of the angle of the scapula. Before its termination it supplies one or two twigs to the elevator of the scapula; it is lost in the rhomboidei, on the under surface. Nerve of rhomboid muscle.

* *Dissection.*—By reflecting the rhomboidei muscles towards the spinous processes, and removing the loose areolar tissue, the thin upper serratus muscle which is beneath them will be laid bare. Dissection.

* *THIRD LAYER.*—In this stratum are the following muscles:—the serratus posticus superior and inferior, with the splenius. Third layer of muscles.

* The *SERRATI* muscles are very thin, and receive their name from their toothed attachment to the ribs. They are two in number, superior and inferior, and have aponeurotic origins from the spines of the vertebræ. Serrati are two in number.

* The *serratus posticus superior* arises from the ligamentum nuchæ, and from the spinous processes of the last cervical, and two or three upper dorsal vertebræ. The fleshy fibres are inclined downwards, and are attached by slips to the second, third, and fourth ribs, external to their angles. The muscle rests on the splenius. Smaller one at upper part of the thorax.

* The *serratus posticus inferior* (fig. 66, *) occupies the lumbar region, and is wider than the preceding muscle. Its aponeurosis of *origin* is inseparably united with that of the latissimus dorsi and the fascia lumborum, and is connected to the spinous processes of the last two dorsal and first three lumbar vertebræ. The fleshy fibres ascend to be *inserted* by offsets into the last four ribs in front of their angles, each successive process extending further forwards than the one below. This muscle lies on the mass of the erector spinæ, and with it the vertebral aponeurosis is united. Larger muscle at lower part of thorax.

* The *vertebral aponeurosis* is a fibrous expansion, which is spread over the fourth layer of muscles, and confines the erector spinæ in the hollow by the side of the spinous processes. Inferiorly it is thickened by the tendons of the latissimus and lower serratus; but it is continued above beneath the splenius, without joining the upper serratus, and blends with the deep fascia of the neck. Internally it is attached to the spinous processes. Externally it is connected to the posterior third of the iliac crest, blending with Connections.

Vertebral aponeurosis.
Attachments.

the tendon of the latissimus; also to the fascia lumborum; and to the ribs and a thin fascia over the intercostal muscles. Below, between the pelvic and vertebral attachments, it blends with the underlying tendon of the erector spinæ and multifidus.

Dissection. * *Dissection.*—The superior serratus is to be cut through, and the subjacent vertebral aponeurosis taken away, and then the splenius muscle will be denuded.

Splenius has two parts. The SPLENIUS muscle consists of cervical and cranial parts, which are named respectively splenius colli and splenius capitis. The two are united at their origin.

One to the neck. The *splenius colli* arises from the spines of the three or four upper dorsal vertebræ above the sixth. Ascending in the neck, the muscle is inserted by tendinous processes into the tips of the posterior transverse processes (diapophyses) of the upper three cervical vertebræ, behind the attachment of the elevator of the angle of the scapula.

One to the head. The *splenius capitis* (fig. 66, *) arises from the spines of the last cervical and first two dorsal vertebræ, and from the ligamentum nuchæ as high as the third cervical vertebra. The fleshy fibres ascend, and are inserted by a thin tendon into the apex and outer surface of the mastoid process, and into the bone behind it for about an inch and a half.

Their connections with other muscles. The splenius colli is smaller than the splenius capitis, and its fibres are more oblique. These muscles are beneath the trapezius, the rhomboidei, and the serratus superior; and the insertion into the occipital bone is beneath the sternomastoideus. The complexus muscle can be seen above the upper border of the splenius capitis.

Dissection of fourth layer. *Dissection of the fourth layer.*—To lay bare the complexus muscle in the neck, the splenii must be detached from the spinous processes, and thrown outwards. And whilst the large erector spinæ is being displayed in the dorsal and lumbar regions by the dissector of the upper limb, two prolongations from it to the cervical vertebræ and the head are to be defined by the dissector of the neck. One, a thin narrow muscle, the cervicalis ascendens, is continued beyond the ribs from the sacro-lumbalis or outer piece of the erector spinæ, and is to be separated from the muscles around. The other is a larger offset of the longissimus dorsi, or inner piece of the erector spinæ. Blended at first with the fibres of the longissimus, it is divided afterwards, like the splenius, into a cranial part (trachelo-mastoid) and a cervical part (transversalis colli).

Show the * The serratus inferior is to be detached with the vertebral

aponeurosis from the spines in the dorsal region, and the areolar tissue is to be cleaned from the surface of the large mass of the erector spinæ which now comes into view.

erector
spinæ and
its divisions,
viz.

* Opposite the last rib is the beginning of an inter-muscular interval, which divides the erector spinæ into an outer piece—the sacro-lumbalis, and an inner piece—the longissimus dorsi. By sinking the knife into this interval the sacro-lumbalis may be turned outwards, so as to uncover the fleshy slips of its accessory muscle, which are fixed to the angles of the ribs. A muscular slip (cervicalis ascendens) is prolonged from it to the neck.

Sacro-
lumbalis:

offset to the
neck.

* In preparing the sacro-lumbalis muscle, the external branches of the dorsal nerves with their accompanying arteries will be found.

Vessels and
nerves.

* Before the longissimus can be displayed, it will be needful to raise towards the spinous processes the thin muscular fasciculus of the spinalis dorsi, which lies between that muscle and the spines of the vertebræ in the dorsal region.

Separate
spinalis
dorsi.

* Then the attachments of the longissimus dorsi are to be traced out. Externally it has thin muscular processes of insertion into about the eight lower ribs. Internally it is inserted into the transverse processes of the lumbar and dorsal vertebræ by rounded tendons; and for the purpose of seeing these tendons, the longissimus should be drawn away from the spinous processes, and its superficial aponeurosis must be cut through below the ribs, in the line of separation between the muscle and the multifidus spinæ on its inner side. From this muscle, as from the sacro-lumbalis, a fleshy part (transversalis colli and trachelo-mastoid) is continued into the neck.

Longissimus
dorsi:

offset to the
neck.

* Between the longissimus and the multifidus spinæ are the internal branches of the dorsal and lumbar nerves, and of the intercostal and lumbar arteries.

Vessels and
nerves.

* **FOURTH LAYER.**—In this layer are included the spinalis dorsi; the erector spinæ, with its divisions and its accessory muscles to the neck; and the complexus muscle. Most of the vessels and nerves of the back are in connection with this layer of muscles.

Fourth
layer of
muscles

consists of

* The SPINALIS DORSI is found only by the side of the spines of the dorsal vertebræ, and is united with the longissimus dorsi. Inferiorly it arises by tendinous processes from the spines of the last two dorsal and first two lumbar vertebræ, and by fleshy fibres from the contiguous tendon of the longissimus. From this origin the fibres ascend

spinalis
dorsi.

only along
the dorsal
vertebræ.

forming arches, whose concavity looks inwards, and are connected by tendinous processes to the spines of the dorsal vertebræ as low as the eighth or ninth, or only for half that extent.

Erector
spinæ is
single at its
origin.

* The **ERECTOR SPINÆ** is the muscular mass on the side of the spine in the lumbar region. It is single and pointed below; and its cutaneous surface is covered near the sacrum by a wide and strong tendon, which is common to it and the multifidus spinæ. The muscle *arises* below from the posterior fifth of the crest of the innominate bone at the inner aspect, and many fibres take origin from the superficial tendon: in the lumbar region the fibres are connected by fleshy and tendinous processes to the whole length of each transverse process, to the tubercle (process. accessorius) at the root of the same, and to the layer of the fascia lumborum external to the processes. Opposite the last rib it divides into sacro-lumbalis and longissimus dorsi.

Attach-
ments.

Divides at
the last rib
into two.

Sacro-
lumbalis

is inserted
into six
lower ribs.

* The **SACRO-LUMBALIS** or **ILIO-COSTALIS** is the smallest of the two pieces resulting from the division of the erector spinæ. Its fibres end in six or seven flat tendons, which are connected together by their margins, and are inserted into the angles of as many of the lower ribs. The muscle is continued onwards to the other ribs and the neck by a fleshy part, which constitutes the two under-mentioned muscles:—

Musculus
accessorius

is attached
to six upper
ribs.

* The **MUSCULUS ACCESSORIUS ad sacro-lumbalem** begins by a series of tendinous and fleshy bundles on the angles of the lower six ribs, internal to the tendons of insertion of the outer part or ilio-costalis; and it ends in tendons, which are *inserted* into the remaining ribs (upper six) in a line with the ilio-costalis, and into the posterior transverse process (diapophysis) of the seventh cervical vertebra.

Cervicalis
ascendens

reaches the
neck.

The **cervicalis ascendens** is a muscular slip that prolongs the accessorius into the neck. United with the preceding, this muscle is attached to four ribs (third, fourth, fifth, and sixth), and is inserted into the tips of the posterior transverse processes (diapophyses) of three cervical vertebræ, viz. sixth, fifth, fourth.

Longissimus
dorsi

is inserted
into ribs and
transverse
processes;

is continued
to the neck
by the

* The **LONGISSIMUS DORSI** gradually decreases in size as it ascends along the thorax. Internally the muscle is *inserted* into the tips of the transverse processes of all the dorsal vertebræ by a series of tendinous and fleshy bundles; and externally it is attached to the ribs, except the first two or three, by thin fleshy processes between the tubercle and angle. Its muscular prolongation to the neck is inseparably

united with the upper fleshy fibres, and splits into the two following pieces :—

The *transversalis colli* arises from the transverse processes of the upper six dorsal vertebræ, and is inserted into the posterior transverse processes (diapophyses) of the cervical vertebræ, except the first and last. transversalis colli,

The *trachelo-mastoid* muscle (*transversalis capitis* ?) arises in common with the preceding, and has besides an attachment by distinct tendons to the articular processes of the last three or four cervical vertebræ. The muscle is thin and is inserted beneath the splenius into the upper half of the posterior part of the mastoid process : its insertion is about three quarters of an inch wide.* and to the head by the trachelo-mastoid.

* *Connections of the erector spinæ.*—The erector spinæ and its prolongations occupy the lumbar, thoracic, and cervical parts of the back. In the loins the muscle is contained in an aponeurotic sheath (p. 420), and has the multifidus spinæ on its inner side : its attachment on the inner surface of the innominate bone corresponds in greater part with the origin of the gluteus maximus on the outer side. The superficial tendon, which is common to it and the multifidus, will be described with the last mentioned muscle (p. 436). Opposite the ribs the ilio-costalis and longissimus dorsi are concealed by the muscles of the other layers already examined. In the neck its accessory small muscles lie underneath the splenius and the trapezius :—the *cervicalis ascendens* is attached in a line with, but below the splenius colli ; and the *transversalis colli* and *trachelo-mastoid* are more internal, or between the two last and the *complexus*. Connections of the erector spinæ in the lumbar, dorsal, and cervical regions.

The *COMPLEXUS* is internal to the prolongations from the longissimus dorsi, and converges towards its fellow of the opposite side at the occipital bone. Narrow at its lower end, the muscle arises by tendinous points from the tips of the transverse processes of the upper six dorsal, and the last cervical vertebra ; and from the articular processes of the other cervical vertebræ as high as the third : to the inner side of the muscle is frequently added a fleshy slip from the spines of one or two of the lower cervical vertebræ. From the tendons of origin the fibres pass upwards, the inferior Complexus. Origin.

* The anatomy of the prolongation from the longissimus might be simplified by describing it as the *transversalis* muscle with a double insertion, like the splenius, into the head and neck. In accordance with the nomenclature of the splenius the part to the head might be named *transversalis capitis*, and the part to the neck *transversalis colli*, as at present.

Insertion. more vertically than the superior, to be *inserted* into an impression between the curved lines of the occipital bone, which reaches outwards nearly two inches from the middle line.

Its accessory piece. The *biventer cervicis* is but a part of the preceding, internal to which it lies. It is often described as a separate muscle ; and it has received its name from having two fleshy bellies with an intervening tendon.

Connections. The conjoined complexus and biventer cervicis muscles are concealed by the splenius and the trapezius ; and on the cutaneous surface is a tendinous cross intersection towards the upper end. Two or three of the cervical nerves perforate the complexus. Along the inner side is the semispinalis muscle, with the ligamentum nuchæ. Beneath it are the small recti and obliqui muscles, the semispinalis, and the cervical nerves and vessels.

Dissection of the nerves of the neck *Dissection.*—In the neck the nerves and vessels will be brought into view by detaching the complexus from the occipital bone and the spines of the vertebræ, and raising it with care from the subjacent parts. Beneath the muscle is a dense fascia, in which are contained the ramifications of the internal branches of the four or five highest cervical nerves. All the nerves should be sought with some care, though the first or suboccipital is the most difficult of the set to find : this little nerve is a short trunk, which is contained in an interval between the recti and obliqui muscles near the head, and does not branch into two (inner and outer pieces) in the same regular way as the others ; it will be best found by looking for the small twigs furnished by it to the recti muscles. The inner branches of the others are partly above and partly beneath the fibres of the semispinalis muscle. The external branches are very small ; they are given off close to where the trunks appear, and enter the prolonged parts of the erector spinæ.

and the vessels. In the dissection of the nerves the deep cervical artery is met with on the semispinalis muscle ; a part of the vertebral artery will be found in contact with the suboccipital nerve ; and the occipital artery will be seen crossing the occipital bone.

Nerves and vessels in the dorsal region ; * Opposite the thorax the dorsal nerves and vessels will be readily displayed on the inner side of the longissimus dorsi muscle, on the removal of a little fatty tissue from between the transverse processes. External and internal branches are to be traced from each nerve and vessel into the muscles ; some of the former have been seen in the interval between the sacro-lumbalis and longissimus dorsi.

* The lumbar nerves and vessels resemble the dorsal, and are found in the same line ; but the inner branches are more difficult to recognise. In the lumbar region.

* The sacral nerves are beneath the multifidus spinæ, and will be dissected after the examination of that muscle (p. 436).

* POSTERIOR PRIMARY BRANCHES OF THE SPINAL NERVES. Posterior branches of spinal nerves.
—The spinal nerves, with a few exceptions in the cervical and sacral, bifurcate in the intervertebral foramina into anterior and posterior primary branches. The posterior supply the integument and the muscles of the back, and are now to be learnt.

In the neck.—The posterior primary branches of the cervical nerves are eight in number. All, except those of the first two, appear beneath the posterior intertransverse muscles, and subdivide into internal and external branches. In the neck they divide into two. In the first and second nerves, the posterior primary branch crosses the arch of the vertebra next beneath, after leaving its trunk.

The *external branches* are very inconsiderable in size, and end in the muscles inserted into the transverse processes, viz., the splenius, and the prolongations from the erector spinæ muscle. There is not any external branch to the first, or the suboccipital nerve. External branches are small. None to the first.

The *internal branches* are larger than the external. All are directed inwards beneath the complexus towards the spinous processes ; and those of the lowest three nerves pass in addition beneath the semispinalis muscle. By the side of the spines of the vertebræ cutaneous branches are furnished to the neck and the head, but only by the nerves that are superficial to the semispinalis ; these superficial offsets ascend to the surface through the splenius, the complexus, and the trapezius muscles, and are distributed as before seen (p. 415). In their course to the spine the nerves supply the surrounding muscles, viz., the complexus, semispinalis, multifidus spinæ, and interspinales. Internal branches above three last, give cutaneous offsets.

The inner branches of the second and third nerves end on the occiput, and require a separate notice. Those of second and third.

That of the second nerve, named *great occipital*, appears beneath the inferior oblique muscle to which it gives offsets : it is then directed upwards to the head through the complexus and the trapezius, and ends on the occiput (p. 8). Second ends on head.

The branch of the third nerve supplies an offset to the integument of the neck ; and ascending to the head through the trapezius, is distributed to the lower part of the occiput, Third supplies neck and head.

internal to the great occipital nerve. Usually this nerve joins the preceding both beneath, and superficial to the trapezius.

Suboccipital nerve The *posterior primary branch of the suboccipital* or first spinal nerve, deviates from the others in its course and branching. It is very short, and appears in the interval between the recti and obliqui muscles. In passing from the spinal canal it is placed between the arch of the atlas and the vertebral artery, and below the arched part of the ligament between the first cervical vertebra and the occipital bone (fig. 25). The following branches radiate from the extremity of the nerve :—

ends in the muscles. One enters the under surface of the complexus near the cranial attachment. A slender branch is furnished to each of the small muscles bounding the space in which the nerve is contained, viz., the rectus major and minor, and the superior and inferior oblique : the offset to the last muscle joins often the inner branch of the second cervical nerve. Occasionally this nerve gives a cutaneous branch to the occiput.*

Posterior cervical plexus. *Posterior cervical plexus.*—The suboccipital nerve and the internal branches of the next two cervical nerves are connected sometimes by offsets beneath the complexus ; when such an intercommunication exists, it forms the posterior cervical plexus of M. Cruveilhier.

Dorsal nerves have inner and outer branches. * In the *dorsal region*.—The posterior primary branches of the dorsal nerves are twelve in number, and appear between the transverse processes. Each nerve soon divides into an internal and an external piece, which are distributed after the same plan as those in the neck. Cutaneous offsets are furnished from the branches, but not commonly from both branches of the same nerve.

Outer branches of upper six end in muscles, * The *external branches* increase in size from the first to the last, and are differently distributed above and below. The *upper six* or eight pass beneath the longissimus and its cervical prolongation, as far as the interval between the longissimus and the ilio-costalis, and end by supplying these muscles and the levatores costarum. The *lower six* or four have a similar arrangement and distribution with respect to the muscles ; but, after reaching the interval between the ilio-costalis and the longissimus dorsi, they are continued to the surface through the serratus and latissimus muscles, nearly in a line with the angles of the ribs.

lower six give cutaneous offsets.

* See foot note to p. 139 of the first edition of this work.

* The *internal branches* decrease in size from above downwards. The *upper six* are directed inwards between the semispinalis dorsi and multifidus spinæ muscles, and become cutaneous along the side of the spinous processes by perforating the rhomboideus and trapezius muscles. Offsets are supplied to the muscles between which they are placed. The *lower six* are small in size, and end in the multifidus spinæ muscle.

Inner branches of upper six have cutaneous offsets.

Lower six not.

* *In the loins.*—The posterior primary branches of the lumbar nerves are five in number, and appear between the erector and multifidus spinæ. In their mode of dividing and general arrangement they resemble the dorsal nerves. Cutaneous offsets are furnished only by the external set of branches.

Lumbar nerves are divided into two.

* The *external branches* enter the fibres of the erector spinæ, and supply it and the small intertransverse muscles. The first three pierce the erector spinæ, and become cutaneous after perforating the aponeurosis of the latissimus. The outer branch of the last nerve is connected with the corresponding part of the first sacral nerve by an offset which lies near the bones.

External branches give cutaneous from first three.

* The *internal branches* are supplied to the multifidus spinæ muscle. Near their origin they are difficult to find, in consequence of being contained in grooves close to the articular processes of the neural arches.

Internal branches end in the muscles.

* **VESSELS IN THE BACK.**—The vessels now dissected are the occipital and the deep cervical artery; part of the vertebral artery; and the posterior branches of the intercostal and lumbar arteries of the aorta. Veins accompany the arteries for the most part.

The vessels are

In the neck.—The vessels in the neck are the occipital, the vertebral, and the deep cervical.

in the neck.

The *occipital artery* courses along the occipital bone. Appearing from beneath the digastric muscle, the vessel is directed backwards beneath the sterno-mastoideus, the splenius, and sometimes the trachelo-mastoideus, but over the obliquus superior and complexus muscles. Near the middle line of the body it perforates the trapezius and ascends to the occiput, on which it is distributed (p. 6). It supplies the surrounding muscles, and furnishes the following branch to the neck:—

Part of the occipital artery,

which gives a

a. The *cervical branch* (r. princeps cervicalis) distributes twigs to the under part of the trapezius, and passing beneath

cervical branch.

the complexus, anastomoses with the vertebral and deep cervical arteries.

Part of the
vertebral
artery.

The *vertebral artery* lies on the posterior arch of the first vertebra, behind the articulating process of the bone; and appears in the interval between the straight and oblique muscles, as it passes into the skull below the ligament between the atlas and the occipital bone. Small branches are supplied by the vessel to the surrounding parts. Beneath the artery is the suboccipital nerve.

Deep cervi-
cal artery.

The *deep cervical artery* is a branch of the superior intercostal (of the subclavian, p. 76), and resembles the posterior branches of the other intercostal arteries. Passing backwards between the transverse process of the last cervical vertebra and the neck of the first rib, the vessel appears in this dissection between the complexus and semispinalis muscles. Finally the artery ascends as high as the upper border of the semispinalis muscle, and anastomoses with the cervical branch of the occipital artery. The contiguous muscles receive branches from the deep cervical artery, and anastomoses are formed between its offsets and those of the vertebral artery.

Intercostal
arteries are
split into

* *In the dorsal region.*—The posterior branches of the intercostal vessels accompany the nerves between the vertebræ and the anterior costo-transverse ligaments. In the back they are divided like the nerves into inner and outer branches.

inner and

* The *inner branches* end in the fleshy mass of the multifidus spinæ and semispinalis muscles, and furnish small cutaneous offsets with the nerves.

outer
branches,

* The *external branches* cross beneath the longissimus dorsi, and supply it and the erector spinæ. Like the nerves, the lowest branches of this set are the largest because they extend to the surface.

and give a
branch to
spinal cord.

As the dorsal branch of the intercostal artery passes by the intervertebral foramen, it furnishes a small *intraspinous artery* to the cord and its membranes, as well as other twigs to the vertebræ.

Lumbar
arteries

* *In the loins.*—The posterior branches of the lumbar arteries divide, like the intercostal, into internal and external pieces, as soon as they reach the interval between the longissimus dorsi and multifidus spinæ. Each gives also a *spinal branch* to the spinal canal, and to the spinal cord with the investing membranes.

are also
divided into

inner and

* The *internal branches* are small, and end in the multifidus spinæ muscle.

* *b.* The *external branches* supply the erector spinæ, and some are continued onwards to the integuments with the superficial nerves. outer branches.

VEINS.—With the deep cervical artery is a large vein, *vena profunda cervicis*, which communicates with the occipital and other deep veins in this region, forming the posterior plexus of the neck; and then passes forwards between the transverse processes with its companion artery to join the vertebral vein. Veins are deep cervical.

The *occipital vein* lies with its artery, and communicates sometimes with the lateral sinus of the skull through the mastoid foramen. occipital.

The *dorsal* and *lumbar* veins correspond in their branching and distribution with the arteries they accompany, and end in the intercostal veins. dorsal and lumbar.

In contact with the spinous processes and plates of the vertebræ is a deeper set of veins (*dorsi spinal*), which anastomose freely together, and enter the veins in the interior of the spinal canal. and deep veins.

Dissection of the fifth layer.—Most of the remaining fifth layer of muscles of the back are uncovered by the previous dissection. Thus, between the first two vertebræ and the occipital bone lie the small straight and oblique muscles. Dissection of the last layer of muscles.

* In the cervical and dorsal regions the semispinalis muscle will be seen, with the small interspinal muscles internal to it; and occupying a corresponding position in the loins is the multifidus spinæ. The small intertransverse muscles of the lumbar region will be found by cutting through the erector spinæ.

* **FIFTH LAYER.**—In this layer are the following small muscles;—the recti and obliqui, the semispinales, interspinales, multifidus spinæ, and intertransversales. Muscles of the fifth layer.

The **RECTUS CAPITIS POSTICUS MAJOR** is the largest of the three muscles between the occipital bone and the first two vertebræ. It *arises* from the side of the spine of the second vertebra, and is *inserted* into the outer part of the inferior curved line of the occipital bone for about an inch, as well as into the surface below it. Its upper attachment is beneath the superior oblique muscle. This muscle is directed outwards very obliquely, and forms one side of the triangular space which contains the suboccipital nerve. Rectus capitis major; between axis and occipital bone.

The **RECTUS CAPITIS POSTICUS MINOR** is internal to the preceding, and is much smaller than it. *Arising* from the neural arch of the atlas, the muscle ascends to be *inserted*, close to the middle line, into the inferior curved ridge of the Direction.
Rectus capitis minor
passes from atlas to occipital bone.

Connections. occipital bone, and between this and the foramen magnum. This small muscle is fan-shaped, and is deeper than the rectus major : it covers the ligament between the atlas and the occipital bone.

They are interspinals. The two small recti muscles correspond with the interspinales between the other vertebræ.

Obliquus inferior, to first two vertebræ. The OBLIQUUS INFERIOR lies obliquely between the first two vertebræ. It arises from the spinous process of the axis, external to the rectus major muscle, and is inserted into the posterior transverse process (diapophysis) of the atlas.

Obliquus superior. The OBLIQUUS SUPERIOR takes origin from the upper part of the transverse process of the atlas, where the preceding muscle terminates ; and it is directed inwards to be inserted between the curved lines of the occipital bone, near the mastoid process. This muscle is concealed by the complexus and trachelo-mastoideus, and crosses the vertebral artery.

extends from atlas to occiput. Its insertion is beneath the splenius, but above the rectus major muscle.

Connections. The SEMISPINALIS occupies the vertebral groove in the dorsal and cervical regions, and extends from the transverse and articular processes to the spines of the vertebræ. The lower part of the muscle is called semispinalis dorsi, and the upper part semispinalis colli.

is divided into. The *semispinalis dorsi* arises from the transverse processes of the dorsal vertebræ, from the tenth to the sixth ; and it is inserted into the spinous processes of the upper four dorsal and the last two cervical vertebræ.

semi-spinalis dorsi, and. The *semispinalis colli* arises from the transverse processes of the upper five or six dorsal vertebræ, and from the articular processes of the cervical vertebræ except the first three : it is inserted into the spines of the cervical vertebræ above the attachment of the semispinalis dorsi, the atlas not receiving any slip.

semi-spinalis colli. The semispinalis muscle is covered by the complexus, and by the deep cervical artery and some cervical nerves. To its inner side is the multifidus spinæ muscle.

Connections. * The INTERSPINAL MUSCLES are placed as their name expresses : they are arranged in pairs, a muscle being on each side of the interspinous ligament, and are best seen in the neck and loins.

Inter-spinal muscles in pairs. In the *cervical region* the muscles are situate between the spinous processes, but they are absent from the interval between the first two vertebræ. They are small round bundles, and are attached above and below to the bifurcated apices of the spines.

in the neck ;

* In the *dorsal region* the muscles are rudimentary, and ^{in the back;} exist only between the first, or the first two pairs of the vertebræ; and between the pair above the lowest dorsal vertebra, as well as between this and the first lumbar vertebra.

* In the *lumbar region*, as in the cervical, there is a pair ^{in the loins.} in each interspinous space. Here they are thin flat muscles, which reach all along the spines.

* The INTERTRANSVERSE MUSCLES lie between the transverse processes of the vertebræ; but only those in the loins ^{Inter-transverse muscles} and the back are now dissected.

In the *neck* they are double, like the interspinal muscles ^{in the neck,} of the same vertebræ (p. 181).

* In the *dorsal region* they are single rounded bundles, ^{in the dorsal region,} and are found only between the lower processes: their number varies from three to six. Between the upper processes tendinous bands take their place.

* In the *lumbar region* the anterior set are four thin and ^{in the loins.} fleshy muscular planes between the bony processes. The posterior set are rounded fasciculi, which are attached to the accessory points at the roots of the transverse processes: they have been named *interaccessorii*.

Dissection.—The multifidus spinæ muscle, which fills the hollow by the side of the spinous processes, may be now dissected. The upper part of the muscle is to be prepared and learnt by the dissector of the head and neck. ^{Dissection of multifidus spinæ.} It will ^{In the neck,} be laid bare by cutting through the insertion of the semispinalis muscle.

* Over the sacrum it will be necessary to remove from it, ^{over sacrum and over ribs.} after examination, the thick aponeurosis covering it and the erector spinæ. In the dorsal region, the muscle will appear on detaching and drawing aside the semispinalis from the spines.

* The MULTIFIDUS SPINÆ muscle extends from the sacrum to the second vertebra, and is much larger towards the pelvis than in the neck. It takes *origin* inferiorly from the aponeurosis covering its surface; from the back of the sacrum between the central and external row of processes, as low as the fourth aperture; from the inner surface of the iliac spine (posterior superior) of the hip bone; and from the ligaments connecting this bone to the sacrum. Along the side of the spine, the muscle arises differently from the vertebræ in the several regions:—Thus in the loins it arises by large fasciculi from the accessory and the articular processes; in the dorsal region, from the transverse processes; and in the neck, from the articular processes of the four or

five lower vertebræ. From this origin the fibres are directed obliquely inwards, some extending more than the length of one vertebra, to be *inserted* into the spines and the neural arches of the vertebræ between the first cervical and last sacral.

Insertion. This muscle fills chiefly the vertebral groove, and is concealed by the erector spinæ and the semispinalis. The internal branches of the vessels and nerves of the back lie along its outer border. The following small muscles may be said to be parts of the multifidus.

Connections.

Rotatores spinæ.—These are eleven small muscles beneath the multifidus spinæ in the dorsal region, and are separated from that muscle by fine areolar tissue. Each is attached on the one hand to the tip and the upper edge of a transverse process, and on the other to the lower border of the neural arch of the vertebra next above. The first springs from the transverse process of the second vertebra.

Aponeurosis of multifidus. * The *aponeurosis* common to the multifidus and erector spinæ is fixed firmly to the surrounding bones, and furnishes attachment to the muscular fibres. In the middle line it is connected with the spines of the lower lumbar vertebræ, and the spines of the sacrum. On the outer side it is attached to the posterior part of the iliac crest, and to the outer row of tubercles on the back of the sacrum, being connected at the last spot with the great sacro-sciatic ligament. Above, it is continued some way on the surface of the erector spinæ, but further on the longissimus dorsi than the ilio-costalis. Blending with the cutaneous surface below is the vertebral aponeurosis (p. 423).

Dissection of sacral nerves.

* *Dissection.*—To find the branches of the sacral nerves, it will be necessary to remove the part of the multifidus spinæ which covers the sacrum. These nerves are very fine, but three may be detected by following inwards the external branches on the great sacro-sciatic ligament.

The lowest two nerves must be sought on the back of the sacrum, below the attachment of the multifidus spinæ muscle: the fourth comes through an aperture, and the fifth between the sacrum and coccyx.

Five sacral nerves;

are differently distributed.

SACRAL NERVES.—The posterior primary branches of the sacral nerves are five in number. Four issue from the spinal canal by the apertures in the back of the sacrum, and the fifth between the sacrum and the coccyx. The first three have the common division into inner and outer branches, like the other dorsal nerves, but the last two are undivided.*

* See a paper on the mode of branching of the spinal nerves, in the "Lond. Med. Gazette" of Feb. 10, 1843.

* The *first three nerves* are covered by the multifidus spinæ, and divide regularly. First three have

The *inner branches* of the nerves are distributed to the inner and multifidus; and the last is very fine.

The *outer branches* are larger in size, and have communicating offsets from one to another on the back of the sacrum. The outer branch of the first nerve is connected further with the corresponding part of the last lumbar; and that of the third nerve joins in a similar manner the sacral nerve next below. After this looping the nerves pass outwards to the surface of the great sacro-sciatic ligament, where they join a second time, and then become cutaneous.—(See DISSECTION OF THE BUTTOCK.) outer branches :

the last give cutaneous offsets.

* *Last two nerves.*—These nerves, which are below the multifidus, are much smaller than the preceding, and want the regular branching of the others: they are connected by loops with each other, and with the coccygeal nerve, on the back of the sacrum. A few filaments are distributed to the back of the sacrum and the coccyx. Last two are undivided.

* The *coccygeal nerve* issues through the lower aperture of the spinal canal, and may be recognised with care by the side of the coccyx. It is joined by a loop from the last sacral nerve, and ends on the posterior surface of the coccyx. Coccygeal nerve.

* *Small SACRAL ARTERIES* leave the spinal canal with the sacral nerves; they supply the muscular mass of the erector spinæ, and the structures on the back of the sacrum. Anastomoses take place between these vessels and the branches on the back of the sacrum from the gluteal and sciatic arteries. Small sacral arteries.

* *Dissection.*—The examination of the posterior part of the wall of the thorax may be made before the body is again turned. By the removal of the ilio-costalis and longissimus dorsi, opposite the ribs, the small levatores costarum will be uncovered. The hinder part of the external intercostal muscle will be denuded at the same time. Dissection of costal muscles.

* The *LEVATORES COSTARUM* are twelve small fan-shaped muscles, which are connected with the hinder part of the ribs. Each, except the first, *arises* from the apex and lower border of the transverse process of a dorsal vertebra; and is *inserted*, the fibres spreading out, into the upper border of the rib beneath from the tubercle to the angle. The muscles increase in size from above down, and their fibres have the same direction as the external intercostal layer. The first is fixed above to the transverse process of the last cervical vertebra, and below to the outer surface of the first rib. Levatores costarum extend from transverse processes to ribs.

The first.

Other
elevator
muscles.

In some of the four lower muscles a few fibres are continued beyond one rib to that next succeeding. These longer slips have been named *levator longiores costarum*.

Outer
intercostal
muscle,

* The *external intercostal muscle* is continued backwards along the ribs as far as the tubercle, and is overlaid by the elevator muscle. Beneath the muscle are the intercostal nerve and artery.

Dissection.

Dissection.—To trace the anterior and posterior primary branches of the dorsal nerves to their common trunk, the elevator of the rib and the external intercostal muscle are to be cut through in one or more spaces. The intercostal artery with its posterior branch is laid bare at the same time.

Dorsal nerve
has

* The *dorsal nerves* can be now seen to split in the intervertebral foramina into anterior and posterior primary branches.

posterior

* The *posterior* branches are directed backwards, internal to the anterior costo-transverse ligament, and have been already examined (p. 430).

and anterior
branch.

* The *anterior* is named intercostal, and is continued between the ribs to the front of the chest. Its anatomy is learnt in the dissection of the thorax (p. 403).

Intercostal
artery.

* The *intercostal artery* has an almost exact correspondence with the dorsal nerve in its branching and distribution.

CHAPTER VI.

DISSECTION OF THE SPINAL CORD AND ITS MEMBRANES.

THE spinal cord gives origin to the spinal nerves, and is lodged in the canal formed by the bodies and the neural arches of the vertebrae. It is invested by prolongations of the membranes of the brain, which form sheaths around it, and is supported by them in its large canal.

Cord is contained in spinal canal, invested by membranes.

Dissection.—To obtain the cord and its enveloping membranes, it will be necessary to open the spinal canal; but as a preparatory step all the muscles are to be taken from the arches and spines of the vertebrae. The canal may be opened by sawing through the neural arches, on each side, close to the articular processes; and the cuts of the saw should extend to the lower end of the sacrum, but not higher in the neck than the fourth cervical vertebra. As it is difficult to use the saw in the hollow of the lumbar region, a chisel and a mallet will be found useful to divide the vertebral arches.

Dissection to get the cord

When the loose bits of bone have been taken away, the tube of the dura mater will be seen to be covered by some veins and fat, and by a loose areolar tissue sometimes containing fluid, especially at the lower part. The fat may be scraped away with the handle of the scalpel, and the lateral prolongations through the intervertebral foramina are to be defined.

and the membranes.

MEMBRANES OF THE CORD.—Three membranes, like those of the brain, surround the cord, viz. an external tube of dura mater, an internal sheath of pia mater, and an intervening arachnoid or serous covering.

Three membranes of the cord.

The *dura mater* forms a strong tube, and is prolonged from the membrane lining the interior of the skull. Surrounding the cord and the nerves it extends along the spinal canal, and forms a loose sheath as far as the top of

Dura mater surrounds cord loosely.

the sacrum ; but beyond that point it is impervious, and is continued by a slender cord to the back of the coccyx. The capacity of the sheath is much greater than is needful for the contents ; and the size of the sheath is larger in the neck and the loins than in the back.

and is
slightly con-
nected with
bones
around.

It gives off-
sets on
spinal
nerves

and one
central
inferior
piece.

Dissection
to remove
cord

and see next
covering.

Arachnoid
membrane
has a

On the outer aspect the dura mater is smooth, when a comparison is made between it and the part in the skull, for it does not act as a periosteum to the bones. Between it and the osseous surfaces are some vessels and fat ; and it is connected to the posterior common ligament of the vertebræ by a few fibrous bands. On each side the dura mater sends offsets along the spinal nerves in the intervertebral foramina ; and these several offsets become gradually longer inferiorly, where they form tubes which enclose the sacral nerves, and lie for some distance within the spinal canal. In the midst of the tubes into which the dura mater seems to be divided below, will be seen the slender before-men- tioned impervious cord, which descends from the lower part of the sheath of the dura mater to the end of the spinal canal, and blends with the periosteum covering the back of the coccyx.

Dissection.—The sheath of the dura mater with the con- tained cord is to be next removed from the body. For this purpose the lateral processes in the intervertebral apertures are to be cut ; and one or two processes in the lumbar region should be followed outwards beyond the intervertebral ganglion of the contained nerve by cutting away the surround- ing bone. The central prolongation may be now detached with care from the coccyx. Next, the cord and its mem- branes are to be divided opposite the lower cervical vertebræ, and to be removed by cutting the bands that attach the dura mater to the ligament of the bodies of the vertebræ.

When the cord is taken out, it is to be placed on a piece of board, or on a table, with the lateral offsets widely sepa- rated. To show the arachnoid covering, the dura mater is to be slit along the middle, on one or both aspects, as far as the small terminal median cord before referred to ; but the membrane is to be raised whilst it is being cut through, so that the loose arachnoid enveloping the cord may not be injured. Lastly the dura mater is to be fastened back with pins.

The *arachnoid membrane* is the thin serous covering of the cord which is immediately beneath the dura mater. Like the corresponding membrane in the skull, it invests the nervous centre and lines the dura mater, and consists

thus of a visceral and a parietal part; but the visceral piece, around the cord, is much looser than the like part on the brain.

The outer or *parietal* part is inseparably joined to the inner surface of the dura mater, and gives to the membrane a shining appearance.*

The inner or *visceral* layer surrounds the cord loosely, so as to leave a considerable interval between the two (sub-arachnoid space). At the lower part of the spinal canal the loose sheath is much the largest, and envelops the mass of nerves forming the cauda equina. As the different spinal nerves extend to the intervertebral foramina they receive loose sheaths from the visceral part of the arachnoid membrane, and retain the same till they perforate the dura mater.

Dissection.—The subarachnoid space of the cord may be made evident by placing the handle of the scalpel beneath the visceral layer; or by putting a detached piece of the cord in water, with the posterior aspect uppermost, and blowing air beneath the serous membrane.

The *subarachnoid space* is situate between the loose or visceral part of the arachnoid membrane, and the spinal cord invested by pia mater. Larger at the lower than at the upper part of the spinal canal, the space contains a special fluid (cerebro-spinal); and it communicates with the cavity in the interior of the brain by an aperture in the fourth ventricle. Crossing the space at the posterior part of the cord, are bundles of fibrous tissue; in the neck the fibres are most marked, and are collected into an imperfect partition or septum along the middle line: in the space are the serrations of the ligamentum denticulatum, and the roots of the spinal nerves, with some vessels.

Dissection.—For the purpose of seeing the next covering of the cord with the ligamentum denticulatum, the arachnoid membrane is to be taken away.

The *pia mater* is much less vascular on the spinal cord than on the brain. Thicker and more fibrous in its nature, the membrane closely surrounds the cord. It sends a thin prolongation into the anterior median fissure of the cord, and furnishes offsets to the roots of the spinal nerves.

The outer surface of the pia mater is rough. Along the

* This reflection of the membrane over the dura mater is denied by Kölliker. According to the view of this anatomist, the membrane is a simple tube corresponding with the *visceral* layer in the text.

Fibrous
bands are
connected
with it.

And ends
inferiorly
in a fibrous
piece,

which is
called
central
ligament.

The dentate
ligament,

is fixed on
one side to
cord,

and on other
to dura
mater by
points.

Number
and attach-
ment of
these,

Vessels and
nerves of
dura mater,

of arach-
noid ;

front is a central, anterior fibrous band (*linea splendens*, Haller) ; and on each side another fibrous band, the *ligamentum denticulatum*, is attached to it. Scattered through the membrane are branched pigment cells, which give frequently a darkish appearance in the cervical region where they most abound.

Where the *medulla spinalis* ceases, viz. about the lower part of the body of the first lumbar vertebra, the investing tube of the *pia mater* is suddenly reduced in size, and has the appearance of a round fibrous cord. This cord-like part reaches towards the end of the spinal canal. It is unprovided with nervous substance, except for a short distance, and is blended with the central impervious prolongation of the *dura mater* on a level with the upper part of the sacrum. It serves to fix the lower end of the medulla, and has been named, from that circumstance, the *central ligament* of the cord. A vein and artery accompany this fibrous piece, and mark it out from the surrounding nerves.

The *ligamentum denticulatum* is the white fibrous band on each side of the spinal cord. It is named from its serrated appearance ; and it has the same structure as the *dura mater*, except that it wants an epithelial covering.

Situate between the anterior and posterior roots of the nerves, the band reaches upwards to the *medulla oblongata*, and ends inferiorly on the lower pointed extremity of the cord. Internally it is united to the *pia mater*. Externally it ends in a series of triangular or tooth-like projections, which are fixed at intervals along the *dura mater*, each being about midway from above down between the apertures of the roots of two spinal nerves. There are twenty or twenty-one denticulations, of which the first is attached to the *dura mater* opposite the margin of the occipital foramen, between the vertebral artery and the hypoglossal nerve ; and the last is inserted opposite the last dorsal or the first lumbar vertebra. This fibrous band supports the spinal cord, and has been called a ligament from that circumstance.

Vessels and nerves of the membranes.—The *dura mater* of the cord has but few vessels in comparison with that in the skull, for its office is different. Nerves have not yet been traced into it, though they have been found on the vessels supplying the cord and its membranes.

The *arachnoid* is sparingly supplied with vessels like serous membranes in general, and proof of its containing nerves is yet wanting.

The *pia mater* has a network of vessels in its substance,

though they are much less marked than in the membrane on the brain, and from them offsets enter the cord. In its substance are many nerves; these were supposed by Purkinje to be derived from the sympathetic, but Remak shows that their chief source is from the posterior roots of the spinal nerves.

Dissection.—The arachnoid membrane is to be taken from the fibrils of the roots of one nerve; and the roots of the nerve are to be traced outwards to their transmission through two apertures in the dura mater. One or more of the lumbar offsets of the dura mater, which have been cut of some length, are to be laid open to show the contained ganglion. The student should define one ganglion, and should trace the roots of the nerve to their union beyond the ganglion.

SPINAL NERVES.—The spinal nerves are thirty-one in number; and their trunks are constructed by the blending together of two roots (anterior and posterior) in the intervertebral foramina (fig. 67).

They are divided into groups corresponding with the regional subdivisions of the spinal column, viz., cervical, dorsal, lumbar, sacral, and coccygeal. In each group the nerves are equal to the number of the vertebræ, except in the cervical region of the spine where they are eight, and in the coccygeal region where there is only one. In consequence of the cervical nerves exceeding the number of the vertebræ, the last is placed below the seventh vertebra; and the lowest nerve of each group, except the coccygeal, will be below its corresponding vertebra.

Each nerve divides into two, viz., anterior and posterior primary branches; the former of these is distributed to the front of the body and the limbs, and the latter is confined to the hinder part of the trunk.

ROOTS OF THE NERVES.—Two roots or bundles of fibrils (anterior and posterior) attach the nerve to the spinal cord; and these unite together to form the trunk of the nerve either in the intervertebral foramen, or, it may be, in the spinal canal. The posterior root is marked by a ganglion, but the anterior root is aganglionic.

The *posterior* or *ganglionic roots* (fig. 67, s) surpass in size the anterior, and are formed by larger and more numerous fibrils. They are attached to the side of the cord between the posterior and lateral columns in a straight line, which they keep even to the last nerve. In their course to the trunk of the nerve the fibrils pass outwards, converging

Dissection
of roots of
nerves.

Trunks
of spinal
nerves.

Number
and arrange-
ment in
groups.

Last nerve
of a group
below the
vertebra.

Primary
divisions.

Each nerve
has two
roots,
anterior
and pos-
terior.

Posterior
root is
larger than
anterior:

forms two
bundles

that enter
the gan-
glion.

Anterior
root is
without
ganglion,

has a sepa-
rate opening
in dura
mater,

and joins
posterior
root beyond
ganglion.

Characters
of roots.

Some sets
of fibrils
join.

Posterior
root largest,

proportion-
ally largest
in neck.

Roots in-
crease above
down,

except dor-
sal and
sacral.

to an aperture in the dura mater opposite the intervertebral foramen; as they approach that aperture they are collected into two bundles which, lying side by side, receive a sheath from the dura mater, and enter the intervertebral ganglion.

Fig. 67.*



posterior root to the intervertebral foramen, the fibrils enter a distinct opening in, and have a separate sheath of the dura mater. In their further course to the trunk of the nerve, they pass over the ganglion of the other root, without joining it; and finally the two roots are joined beyond the ganglion to form one trunk.

Characters of the roots.—Besides the relative size between the two roots, the following characters are to be noted :—

Union of the fibrils.—The fibrils of contiguous anterior and posterior roots in the same line may be united; but the anterior is never joined by the posterior root, or the opposite.

Relative size of the roots.—The posterior root is larger than the anterior, except in the suboccipital nerve; and the number of the fibrils is also greater. Further, the posterior is proportionally larger in the cervical than in any other set of the nerves. In the dorsal nerves there is but a very slight difference in favour of the hinder root.

Size of the roots along the cord.—Both roots are larger where the nerves for the limbs arise, than at other parts of the cord; and they are greater in the nerves to the lower than in those to the upper limbs: so that the nerve roots increase from above down, except at the two following spots, viz., the lower extremity of the cord, and in the dorsal region where they are of much the same size from the second to the last.

* A plan of the origin of the nerves and the fissures of the spinal cord.—*r.* Anterior, and *s.* Posterior roots of the nerves.

a. Anterior fissure. *p.* Posterior fissure, and *b.* Lateral fissure: *c.* The line of attachment of the anterior roots. *e.* Central gray substance of the spinal cord.

Direction and length.—As the apertures of transmission from the spinal canal are not opposite the place of origin of the nerves, the roots must be directed more or less obliquely. This obliquity increases from above down ; for in the upper cervical nerves the roots are horizontal, but in the lumbar and sacral nerves they have a vertical direction around the end of the medulla spinalis. The appearance of the long fibrils around the end of the cord has much resemblance to the extremity of a horse's tail, and bears appropriately the term *cauda equina*.

Oblique in their course.

Most so inferiorly,

and form cauda equina.

The length of the roots increases proportionally as the obliquity, so that between the origin and the place of exit of the roots of the lower cervical nerve it amounts to the depth of one vertebra ; in the lowest dorsal nerve it equals the depth of two vertebrae ; and in the lumbar and sacral nerves each succeeding root becomes a vertebra longer, for the cord does not reach beyond the first lumbar vertebra.

Length increases

from above down.

Place of union of the roots.—Commonly the roots unite as before stated in the intervertebral foramina ; and the trunk of the nerve bifurcates at the same spot into its anterior and posterior primary branches. But deviations from this arrangement are found at the upper and lower ends of the spinal column in the following nerves :—

Union of the roots in intervertebral foramen,

The roots of the first two cervical nerves join in each instance on the neural arch of the corresponding vertebra ; and the anterior and posterior branches diverge from the trunk in that situation.

except in first two cervical,

In the sacral nerves the union of the roots takes place within the canal ; and the primary branches of the nerves issue by the apertures in the front and back of the sacrum.

and the sacral

The roots of the coccygeal nerve are also united in the spinal canal ; and the anterior and posterior branches of its trunk escape by the lower aperture of the canal.

and coccygeal nerves.

The intervertebral ganglia.—Each posterior root is provided with a ganglion ; but sometimes the first or suboccipital nerve is without a posterior root and a ganglion. The ganglia are reddish in colour, and oval in shape whilst they are surrounded by the dura mater ; and their size is proportioned to that of the root. By means of the previous dissection, the ganglion may be seen to be bifid at the inner part, where it is joined by the fibrils of the root ; so that it might be said to possess two small ganglia, one for each bundle of fibrils, which are joined together at their outer ends.

Number of ganglia

form

construction.

Each is bifid.

Situation of the ganglia.—The ganglia are placed com-

Their usual situation.

Exceptions in neck.	only in the intervertebral foramina, but where the regular position of those apertures is wanting, as at the upper and lower extremities of the spinal canal, they have the following situation:—In the first two nerves they lie on the neural arches of the atlas and axis. In the sacral nerves they are contained in the spinal canal. In the coccygeal nerve the ganglion is also within the canal, and about the middle of the long posterior root (Schlemm).
Sacral and coccygeal.	
Arteries of cord are	VESSELS OF THE SPINAL CORD. —The arteries on the surface of the cord are anterior and posterior spinal. The veins do not resemble the arteries in their branching.
anterior spinal, a single artery,	The <i>anterior spinal artery</i> occupies the middle line of the cord beneath the fibrous band before alluded to in that position. It commences at the medulla oblongata by the union of two small branches of the vertebral artery (p. 193); and it is continued to the lower part of the cord by a series of anastomotic branches, which are derived from the vertebral and ascending cervical arteries in the neck, and from the intercostal arteries in the back. Inferiorly it supplies the roots of the nerves forming the cauda equina, and ends on the central fibrous prolongation of the cord. The branches of this artery ramify in the pia mater, and are distributed to the substance of the cord, some entering the median fissure.
and is continued by anastomotic branches.	
Termination.	
Offsets.	
Posterior arteries are two;	The <i>posterior spinal arteries</i> , one on each side, are continued from the upper to the lower part of the cord, behind the roots of the nerves. These vessels begin superiorly by offsets from the vertebral artery, and their continuity is maintained by a series of anastomotic branches, which enter the canal along the spinal nerves, and are furnished from the same source as the twigs reinforcing the anterior spinal artery. Dividing into small branches, the vessels of opposite sides form a free anastomosis around the posterior roots, and some offsets enter the fissure of the cord.
are continued along cord like anterior,	
lie on sides of cord;	
Veins.	The <i>veins</i> of the spinal cord are very tortuous, and form a plexus on the surface. At intervals larger trunks arise, which accompany the spinal nerves to the intervertebral foramina, and end in the veins outside the spinal canal.
Termination at top of cord.	Near the top of the cord the veins are united into two or more small branches; these join in the skull the inferior cerebellar, or the petrosal sinuses, after communicating with the vertebral veins.
Situation of the cord.	The SPINAL CORD (<i>medulla spinalis</i>) is the cylindrical elongated part of the cerebro-spinal centre, which is enclosed within the spinal canal. Invested by the membranes before

examined, the medulla occupies about two thirds of the length of the vertebral canal, and is much smaller than the bony case surrounding it. Extent.

The extent of the cord is from the level of the atlas to the lower border of the first lumbar vertebra, but its termination inferiorly may be a little higher or lower than that spot. Its length is usually from fifteen to seventeen inches. Superiorly the cord joins the medulla oblongata; and inferiorly it becomes pointed, being sometimes marked by one or two swellings, and ends in the fibrous prolongation of the pia mater named the central ligament of the cord. In the embryo before the third month the medulla reaches all the length of the spinal canal, but it gradually recedes as the surrounding bones enlarge faster than it, until it takes the position it has in the adult. Its extent varies below.
Length.
Inferior termination in the adult and in the embryo.

The size of the spinal cord is much increased where the nerves of the limbs are attached. There are therefore two enlargements on it:—one is opposite the lower part of the neck, reaching as high as the third cervical vertebra; the other is smaller, and is on a level with the last dorsal vertebra. In the cervical enlargement the greatest thickness is from side to side; but in the lower swelling the measurement of the cord is greatest from before back. Its size increased where nerves of limbs are attached.

Whilst the pia mater remains on the cord, the anterior surface is distinguished from the posterior by the central fibrous band and the anterior spinal artery; and by the irregular line of the anterior roots, which approaches the centre towards the lower end. Anterior surface distinguished from posterior.

Dissection.—For the examination of the structure the student should possess a piece of the medulla which has been hardened in spirit, for the cord which is obtained from the spinal canal at this period, is not fitted for the purpose of dissection. Supposing the pia mater removed from the surface, without the roots of the nerves being detached, the student will be able to observe the following divisions in the cord:— Dissection to see constituents of cord.

FISSURES OF THE CORD (fig. 67).—On the anterior and posterior aspects of the cord is a median longitudinal cleft—the anterior and posterior median fissures, which mark its division into halves; and along the line of the posterior roots of the nerves, in each half, is another slit—the lateral fissure. Fissures of the cord are,

The *anterior median fissure* (fig. 68, a) is wider than the posterior, and penetrates about one third of the thickness of the medulla. It is lined by a piece of the pia mater, and anterior median.

is rather enlarged, it is cased with a more transparent stratum of small nerve cells, which has been named the *substantia gelatinosa* (Fig. 69, ³).

The anterior extremity or cornu (Fig. 69, ²) is shorter and thicker than the other, and projects towards the anterior roots without reaching the surface of the cord. Its end has an irregular or zigzag outline.

Mr. Clarke † describes two special tracts in connection with the gray crescent; one on the

outer and the other on the inner side, which extend through the cord below the cervical swelling, and with which the roots of the nerves are connected.

The inner tract or the *posterior vesicular column* (Fig. 69, ⁸) is close behind the gray commissure, and consists of central interlacing fibres (cylinder) derived from the posterior roots of the nerves; and of circumferential stellate nerve cells of various sizes, continuous also with the roots.

This column is largest at the upper part of the lumbar swelling of the cord; and at the middle of the cervical enlargement the central part (cylinder) disappears, and only cells prolong it as far as the first pair of nerves.

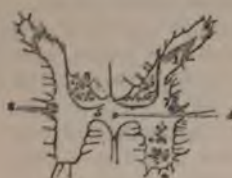
The outer or *intermediate tract* (fig. 69, ⁶) (*tractus intermedio-lateralis*) is a collection of small and rather transparent but uniformly-sized cells, which is opposite the gray commissure, and projects into the lateral column of the cord. Its cells are reached by "both the posterior and anterior roots of the spinal nerves;" and other fibres are prolonged from it into the crescent, and through the gray commissure to the tract of the other side.

* A representation of the gray substance in the interior of the spinal cord, near the middle of the dorsal region (Clarke). Some figures have been inserted to explain Mr. Clarke's description of the crescent. 1. Posterior cornu (*caput cornu*, Clarke) of the crescent. 2. Anterior cornu. 3. Casing of the *substantia gelatinosa*. 4. Central canal of the cord. 5. Transverse commissure: the part in front of the canal is named anterior, and the part behind it posterior commissure by Mr. Clarke. 6. *Tractus intermedio-lateralis*. 7. *Cervix cornu* of Clarke, reaching from the anterior points of the *substantia gelatinosa* to the level of the canal. 8. *Posterior vesicular column*.

† Further researches on the gray substance of the spinal cord. By J. Lockhart Clarke, F.R.S. *Philosoph. Trans. of the Royal Society for 1859. Part I.*

Substantia gelatinosa.

Fig. 69.*



Special tracts of crescent.

Posterior vesicular column.

Construction, size, and extent.

Tractus intermedio-lateralis.

Cells in it joined by nerve roots.

Largest in the upper part of the dorsal region, the tract ceases in the cervical enlargement of the cord. Above that spot there is a collection of cells in a line with it, and seeming to continue it upwards, which is traversed by the roots of the spinal accessory and the spinal nerves.

Size and ending.

Accessory part.

b. The *white substance* of the cord is composed chiefly of nerve fibres disposed longitudinally in bundles, so as to give passage to intermediate vessels. By the projection of the cornua of the gray crescent towards the surface, each half of the cord is separated more or less completely into three parts—*anterior, middle, and posterior*, corresponding with the columns of the cord; but the anterior and middle portions are united because the anterior cornu does not reach the surface.

White substance of the half of the cord.

Modifications in the gray and white substance.—The white substance is most abundant in the neck and back; and the gray substance is more abundant in proportion to the white in the lumbar region.

Gray and white substance vary.

The cornua of the gray crescents decrease in length from above down, especially the posterior, and towards the end of the cord they blend in one indented or cruciform mass.

Crescents alter their shape.

ORIGIN OF THE NERVES.—The deep origin of the spinal nerves is uncertain, like that of the cranial nerves, but the fibrils in each root enter the gray matter of the cord.*

Deep origin of nerves uncertain.

The *anterior root* traverses the longitudinal fibres of the antero-lateral column in distinct bundles; and entering the anterior cornu of the gray crescent, it is resolved into three sets of fibres, *external, internal, and middle*.

Anterior root enters crescent and ends in lateral column,

The outer set penetrate into the anterior and lateral columns.

The inner set pass through the anterior column to the anterior median fissure, and cross to the opposite half of the cord, decussating with like fibres of the opposite side.

anterior column of other side,

The middle set enter the substance of the crescent, and are lost in it and the cells of the intermediate tract (fig. 69, c).

and the crescent.

The *posterior root* pierces chiefly the posterior column of the cord, its fibres interlacing therein, and enters the posterior cornu of the crescent; but a few fibres penetrate by the lateral fissure. It terminates in two bundles of fibres, which are specially connected with the vesicular column.

Posterior root enters crescent,

One bundle courses round the outer side of the vesicular column and joins by

* The description of the origin of the nerves embodies the opinions of Mr. Clarke. See Transactions of the Royal Society for 1851 and 1859.

some fibres
vesicular
and lateral
column:

by other
fibres,

the gray
commissure,

the cres-
cent,

and lateral
column.

Vessels of
the spinal
canal.

Source of
the intra-
spinal
arteries.

Distribution
to the verte-
bræ and the
cord

by loops ;

and a cen-
tral vessel.

Intraspina
veins are
large.

anterior
longitudinal

cular column (fig. 69, ^a), some fibres enclosing, and others interlacing in the part called cylinder ; whilst the rest escape into the lateral column of the cord, becoming longitudinal.

The second bundle proceeds to the vesicular column along the inner side of the cornu. Some of its fibres interlace in the column. Others sweep round the outer side and are prolonged forwards into the crescent and the intermediate tract, as well as into the transverse commissure behind the central canal. Before the bundle reaches the vesicular column, a few fibres are reflected to the gelatinous substance, and escape into the lateral column of the cord.

INTRASPINAL VESSELS.—Arteries supply the cord and its membranes in the interior of the spinal canal, and the bodies of the vertebræ. The veins form a remarkable plexus within the canal, but this will not be seen unless the veins have been specially injected.

The *intraspinal arteries* are derived from the vessels along the sides and front of the spinal column, viz. from the vertebral and ascending cervical in the neck, from the intercostal in the back, and from the lumbar and lateral sacral below. They are distributed after the following plan :—

As each artery enters the spinal canal by the intervertebral foramen, it divides into two branches, upper and lower. From the point of division the branches are directed, one upwards and the other downwards, behind the bodies of the two contiguous vertebræ, but outside the edge of the posterior common ligament, and join in anastomotic loops with offsets of the intraspinal artery above and below. And from the loops extending from one intervertebral foramen to another, offsets are furnished to the periosteum and the bodies of the vertebræ on their posterior surface, as well as anastomotic twigs to connect the arches across the vertebræ.

Besides forming loops, the intraspinal vessels produce a central longitudinal artery, like that on the front of the spinal cord, which lies on the posterior surface of the bodies of the vertebræ, and is reinforced at intervals by offsets from the loops.

The *intraspinal veins* consist of two anterior longitudinal vessels, which extend the whole length of the spinal canal behind the bodies of the vertebræ ; of veins from the bodies of the vertebræ ; and of a plexus of veins beneath the neural arches of the vertebræ.

The *anterior longitudinal* veins are close to the bodies of the vertebræ, one on each side of the posterior common

ligament uniting the bones; and they are irregular in outline, owing to certain constrictions near the intervertebral foramina. They receive opposite the body of each vertebra the veins from that bone; and they send outwards, through the intervertebral foramina, branches of communication with the veins outside the spine in the neck, the dorsal region, and the loins and pelvis.

Veins of the bodies of the vertebræ.—Within the canals in the bodies of the vertebræ are large veins: these join on the front of each vertebra with veins in that situation. Towards the back of the bone the veins are united in an arch, from which two trunks, one for each side, issue by the large apertures on the posterior surface. Escaped from the bone, the trunks diverge,—one to the right another to the left, and open into the large longitudinal veins.

The *posterior spinal veins* form a plexus between the dura mater and the arches of the vertebræ. A large vein may be said to lie on each side of the middle line, which joins freely with its fellow, and with the anterior longitudinal vein by lateral branches. Into this plexus the small veins on the outside of the neural arches pour their contents. Branches from these vessels are directed to the intervertebral foramina, where they end in the veins at the roots of the transverse processes.

CHAPTER VII.

DISSECTION OF THE PERINÆUM.

SECTION I.

PERINÆUM OF THE MALE.

Before the
dissection
pass cath-
eter.

Directions.—THE perinæum may be allotted with greatest advantage to the dissector of the abdomen. Its examination should be made before that of the abdomen, as the distinctness of many of the parts is destroyed soon after death. Before the body is placed in the position suited for the dissection, the student may practise passing the catheter along the urethra.

Place the
body in
position,

and fasten
upwards the
legs.

Position of the body.—Whilst the body lies on the back it is to be drawn to the end of the dissecting table, till the buttocks project slightly over the edge; and a moderately-sized block is to be placed beneath the pelvis, to raise the perinæum to a convenient height. The legs are to be raised and kept out of the way by the following means:—After the knees have been bent, and the thighs bent upon the trunk, the limbs are to be fastened with a cord in their raised position. For this purpose make one or two turns of the cord round one bent knee (say the right), carry the cord beneath the table, and, encircling the opposite limb in the same manner, fasten it finally round the right knee. When the position has been arranged, let the student raise the scrotum, and place a small bit of cotton wool or tow within the anus, but let him avoid distending the rectum.

The surface,
limits.

Superficial limits, and marking of the surface.—The perinæal space in the male is limited, on the surface of the body, by the scrotum in front, and by the thighs and buttocks on the sides and behind.

The anus,

This region is of a dark colour, and is covered with hairs. About its centre is the aperture of the anus, which is posterior to a line extended from the anterior part of the one ischial tuberosity to the other. In front of the anus the

surface is slightly convex over the urethra, and presents a longitudinal prominent line or *raphé*, which divides this part of the space into two halves. Between the anus and the tuberosity of the hip bone the surface is somewhat depressed over the hollow of the subjacent ischio-rectal fossa, especially in emaciated bodies.

a raphé,
hollow on
side of anus,

The margin of the anal aperture possesses numerous converging folds, but these are more or less obliterated by the position of the body and the distension of the rectum ; and projecting oftentimes through and around the opening are some dilated hæmorrhoidal veins (hæmorrhoids).

and folds
and veins
around that
opening.

Deep boundaries.—The deep boundaries of the perineal space will be ascertained, in the progress of the dissection, to correspond with the inferior aperture or the outlet of the pelvis. The limits may be made out by referring to a dry or prepared pelvis, on which the ligaments remain entire ; and the student should trace on the body, the individual boundaries with his finger. In front is the arch of the pubes ; and at the posterior part is the tip of the coccyx. On each side in front is the portion of the innominate bone which forms the pubic arch, viz., from the pubes to the ischial tuberosity ; and still farther back is the great sacro-sciatic ligament extending from the tuber ischii to the tip of the coccyx.

Bounding
parts
around,
same as
those of out-
let of pelvis.

Form.—The space included within these boundaries has the form of a lozenge, and measures about four inches from before backwards, and three inches between the ischial tuberosities. A line from the front of the tuberosity of one side to the corresponding point on the other, will divide the perineal space into two triangular parts. The anterior half (urethral) contains the penis and the urethra, with their muscles and accessory parts. The posterior half (rectal) is occupied by the lower end of the large intestine, with its muscles, &c.

Form of the
space, and
measure-
ments.

A line be-
tween the
tuberosities
divides it
into two.

Depth.—The depth of the perineum from the surface to the bladder may be said to be generally about three inches at the anus, but this measurement varies in different bodies ; and the space has less depth before than behind.

Depth of
the space.

POSTERIOR HALF OF THE SPACE.

This portion of the perineal space contains the lower end of the rectum, surrounded by its elevator muscle and the muscles acting on the anus. The gut does not occupy however the whole of the interval between the pelvic bones ;

Contents
and
general
position.

for on each side is a space, the ischio-rectal fossa, in which is much loose fat, together with the vessels and nerves for the supply of the end of the gut.

Dissection.—The skin is to be raised from this part of the perinæum by the employment of the following cuts :— One is to be made across the perinæum at the front of the anus, and is to be extended rather beyond the ischial tuberosity on each side. A second is to be carried a little behind the tip of the coccyx in the same direction, and for the same distance. The two transverse cuts are to be connected by carrying the knife along the middle line and around the anus. The flaps of skin thus marked out, are to be raised and thrown outwards from the middle line : in detaching the skin from the margin of the anus, the superficial sphincter muscle may be injured without care, for it is close to the skin. The dissector should trace the sphincter back to the coccyx, and forwards for a short distance beneath the remaining piece of skin.

The next step is to bring into view the hollow of the ischio-rectal fossa between the side of the rectum and the tuberosity of the hip bone : on the left side the fat is to be cleaned out of it without reference to the vessels and nerves, but on the opposite side a special dissection is to be made of them. To clean out the fat from the left fossa, begin at the outer margin of the sphincter, and proceed forwards and backwards. In front the dissection should not extend beyond the anus, whilst behind it should lay bare the margin of the gluteus maximus. On the inner side of the hollow the fibres of the levator ani (sometimes very pale) and of the coccygeus are to be dissected. On the outer boundary the pudic vessels and nerve should be denuded : they lie in a canal formed by fascia, and at some distance from the surface.

On the right side it is not necessary to clean the muscular fibres, when following the vessels and nerves. If the student begins at the outer border of the sphincter, he will find the inferior hæmorrhoidal vessels and nerve, which he may trace outwards to their trunks (pudic vessels and nerve) : some branches of the nerve, which join the superficial perinæal and inferior pudendal nerves, are to be followed forwards. In the posterior angle of the space there is a small offset of the fourth sacral nerve ; and external to it, one or more branches of the sciatic nerve and artery are found turning round the border of the gluteus. Near the front of the fossa is a superficial perinæal artery and nerve (of the pudic) ;

Dissection

of sphincter
ani.

Difference
in cleaning
the ischio-
rectal fossa.

Dissection
of left ischio-
rectal fossa.

On right
side, seek
vessels and
nerves.

and the last, after communicating with the hæmorrhoidal nerve, leaves the fossa in front. A second perinæal nerve with a deeper position may be found at the front of the fossa. The trunks of the pudic vessels and nerve may be laid bare on the outer wall.

The ISCHIO-RECTAL FOSSA is the space intervening between the rectum and the ischial part of the innominate bone. On a vertical section the interval would appear to be triangular, with its longest side towards the middle line of the body. Its width is about one inch at the surface, and its depth about two inches; but it is larger behind than before. It is filled by a soft granular fat. The inner or longest side of the space is very oblique, and is bounded by the levator ani and coccygeus muscles, and slightly by the sphincter; but the outer side is straight, and is formed by the obturator muscle and the fascia covering it. In front it is limited by the triangular ligament (to be afterwards seen); and behind are the great sacro-sciatic ligament and the largest gluteal muscle.

Position of vessels.—Along the outer wall are the pudic vessels and nerve; these lie in a tube of fascia, and are one inch and a half from the margin of the ischial tuberosity, but they approach near the edge of the pubic arch towards the front of the space. Crossing the centre of the space are the inferior hæmorrhoidal vessels and nerve,—branches of the pudic. At the anterior part, for a short distance, are two superficial perinæal nerves (of the pudic); and at the posterior part is a small branch of the fourth sacral nerve.

Into this space the surgeon sinks his knife in the first incisions in the lateral operation of lithotomy; and as he carries it from before backwards, he will divide the superficial hæmorrhoidal vessels and nerve.

MUSCLES.—Connected with the lower end of the rectum are three muscles, viz. two sphincters (external and internal) and the levator ani.

The EXTERNAL SPHINCTER (sphincter ani externus) is a flat, thin, orbicular muscle (fig. 70, e), which is pointed in front and behind, and surrounds the lower part of the rectum. The fibres form ellipses around a central aperture, as in other orbicular muscles. The muscle arises posteriorly from the tip of the coccyx by a fibrous band, and from the superficial fascia in front of that bone. Its fibres pass forwards to the anus, where they separate to encircle that aperture; and having united in front of it, they are in-

Situation of the fossa.

Form.

Dimensions.

Boundaries.

Pudic vessels on the outer wall,

and nerves in the space.

First cut in lithotomy enters this space.

Muscles of rectum.

External sphincter surrounds rectum.

Origiu.

Insertion. *serted into the superficial fascia and the central point of the perinæum. The sphincter is close beneath the skin, and*

Fig. 70.*



Connections.

conceals partly the levator ani. The outer border projects over the ischio-rectal fossa, and the inner is contiguous to the internal sphincter.

Internal sphincter a pale band

The INTERNAL SPHINCTER (sphincter ani internus) is situate around the extremity of the intestine, internal to the preceding muscle, and its edge will be seen by removing the mucous membrane. The fibres of this muscle are pale, non-striated, and of a finer texture than in the other sphincter : they encircle the lower part of the rectum in the form of a ring, and are quite separate from the surrounding voluntary muscular fibres. The muscle is only a thickened band of the involuntary circular fibres of the large intestine, which is about half an inch in depth.

Is part of fibres of intestine.

Insertion of levator ani

The LEVATOR ANI muscle (fig. 70, *l*) can be seen only in part ; and the external sphincter should be detached from

* Muscles of the rectum, urethra, and penis (Santorini). 1. Lower part of the pubic arch. 3. Ischial spine of the hip bone. 2. Coccyx ; and 4 side of the sacrum from which the sacro-sciatic ligaments are removed.

Rectal muscles. *c*. External sphincter : within it is the edge of the internal sphincter. *l*. Levator ani. *n*. Fascia covering its front. *f** Coccygeus.

Urethral muscles. *b*. Accelerator urinæ. *c*. Erector penis. *d*. Transversus perinæi.

The probe lies beneath the central point of the perinæum, in which the rectal and urethral muscles are united.

the coccyx, in order that its insertion may be more apparent. The muscle descends from the inner aspect of the hip bone, and is *inserted* below along the middle line from the coccyx to the central point of the perineum :—The most posterior fibres are attached to the side of the coccyx ; and between that bone and the rectum the muscles of opposite sides are united in a median tendinous line. The middle fibres are blended with the side of the intestine (rectum). Whilst the anterior are joined with the fibres of the opposite muscle, in front of the rectum, in the central point of the perineum. This muscle bounds the ischio-rectal fossa on the inner side.

into coccyx,
and tendon
in front of
it ;

into rectum,
and the
centre of the
perineum.

ARTERIES.—The inferior hæmorrhoidal is the only named branch of the pudic artery that is now dissected. Some other small unnamed branches of the pudic and sciatic are visible.

Arteries of
the space.

The *inferior hæmorrhoidal artery* arises from the trunk of the pudic, internal to the ischial tuberosity ; it sends branches inwards across the ischio-rectal fossa to the skin, and the sphincter and levator ani muscles. On the rectum this artery anastomoses with the upper hæmorrhoidal branch, and with the artery of the opposite side. In a well-injected body, some cutaneous branches may be seen to run forwards to the anterior part of the perineum, and to communicate with the superficial perineal branch. *Veins* accompany the artery.

Inferior
hæmorrhoi-
dal
ends on
rectum and
in its mus-
cles.

Branch of
vein.

Other small *muscular branches* of the pudic artery cross the front of the ischio-rectal fossa, and supply the anterior part of the levator ani muscle.

Other offsets
of pudic.

Branches of the sciatic artery appear on the inner aspect of the gluteus maximus at the back of the fossa ; some end in that muscle, and others are continued round its border to the surface.

Branches of
the sciatic.

NERVES.—The branches of nerves to be learned in this part of the perineum are, the inferior hæmorrhoidal ; an offset of the fourth sacral nerve ; and some branches of the small sciatic nerve.

Nerves.

The *inferior hæmorrhoidal nerve* is most frequently a branch of the pudic, though it may have a separate origin from the sacral plexus. Accompanying the artery of the same name across the ischio-rectal fossa, it reaches the margin of the anus, where it terminates in offsets to the integument and the sphincter muscle. Other cutaneous offsets of the nerve turn forwards over the fossa, and communicate with one of the superficial perineal nerves, and with the inferior pudendal (of the small sciatic) on the margin of the thigh.

Inferior
hæmorrhoi-
dal is with
artery of
same name.

Termina-
tion.

Branch of
sacral nerve

supplies
sphincter
and skin.

Offsets of
small
sciatic.

The *hæmorrhoidal branch* of the *fourth sacral nerve* reaches the ischio-rectal fossa by piercing the fibres of the coccygeus, or by passing between that muscle and the levator ani. Appearing in the posterior part of the fossa, close to the coccyx, the nerve ends by supplying the external sphincter, and the integuments behind the anus.

One or two *cutaneous branches* of the *small sciatic nerve* turn round the lower border of the glutæus, in their course to the teguments on its surface.

ANTERIOR HALF OF THE PERINÆAL SPACE.

Contents

and general
position of
parts.

In the anterior part of the perinæal space the tube of the urethra is lodged, as it courses from the interior of the pelvis to the surface of the body. Placed about midway between the bones, the tube is supported at first by a fibrous structure named the triangular ligament of the urethra, and afterwards by the body of the penis.

Muscles are collected around it, to aid in the expulsion of the urine : some of these are superficial to, and some within the triangular ligament mentioned above.

The vessels and nerve lie along the outer side, as in the posterior half, and send inwards offsets.

Incisions to
raise the
skin.

Dissection.—To raise the skin from the anterior part of the perinæum, a transverse cut is to be made at the back of the scrotum, and continued for a short distance (two inches) on each thigh. A second incision along the middle line will allow the flaps of skin to be reflected outwards.

Blow up
superficial
fascia, and
reflect it.

After the removal of the skin the superficial fascia, which covers the front of the perinæal space, is to be blown up by means of a tube introduced beneath it at the posterior part. Each side is to be inflated to demonstrate one partition along the middle line, and another partition on each side between the perinæal space and the thigh which prevents the air passing to the limb. The student is next to cut through the superficial fascia on the left side from the scrotum to the ischio-rectal fossa ; and after the removal of some loose and fatty tissue, the line of attachment of the fascia to the bones externally, and to the triangular ligament posteriorly, will be brought into view. The septum along the middle line should be also defined.

Define partition
between thigh
and perinæal
space.

To demonstrate more completely the attachment of the superficial fascia to the pubic arch between the perinæal space and the thigh, it will be necessary to take away on the

left side the fat from the fascia lata of the limb, external to the line of bone before mentioned.

In the fat of the thigh on the right side the student should seek the inferior pudendal nerve, which pierces the fascia lata one inch anterior to the tuber ischii, and about the same distance from the margin of the pubic arch; and should trace its junction in the fat with the inferior hæmorrhoidal nerve. Afterwards this nerve is to be followed forwards to where it enters beneath the superficial fascia in the middle line.

On right side seek inferior pudendal nerve.

The *superficial fascia* of the anterior half of the perineum is continuous with that of the adjoining regions; and its depth, and the quantity of fat in it, will vary with the condition of the body. It resembles the superficial fascia of the groin and upper part of the thigh, in being separable into two strata;—

Superficial fascia. Its thickness varies

One a subcutaneous fatty layer, continuous with that in other parts of the body, loses its fat towards the scrotum, where it contains involuntary muscular fibres.

It has two layers.

The other deeper, but more membranous layer, is of limited extent, and is connected with the firm subjacent structures. On the outer side it is fixed to the pubic arch of the hip bone, external to the line of the crûs penis and its muscle, extending as low as the ischial tuberosity. Posteriorly the stratum bends down to join the triangular ligament of the urethra. But in front it is unattached, and is continued to the scrotum and the penis. By means of similar connections on both sides, a pouch is formed over the anterior half of the perineal space underneath the superficial fascia. From the under surface of this layer of the fascia a septum dips downwards in the middle line, and divides posteriorly the subjacent space into two parts; but anteriorly this partition is less perfect or disappears.

Connections of deep layer.

Forms a pouch, open in front; this divided by a septum.

Air blown beneath the fascia passes only forwards to the scrotum; and this direction is given to it by the connections of the deep layer with the parts around. Should urine be effused beneath the membranous part of the fascia, the fluid will necessarily be directed forwards, like the air, through the scrotum to the penis and the front of the abdomen.

Course of air and effused urine.

Dissection.—The superficial vessels and nerves are to be traced on the right side of the perineum, by cutting through the superficial fascia in the same manner as on the left side.

Dissection of nerves and vessels on right side.

One long slender artery is the superficial perineal, which gives a transverse branch near its commencement: some-

Branch of
sacral nerve

The *hæmorrhoidal branch* of the *fourth sacral nerve* reaches the ischio-rectal fossa by piercing the fibres of the coccygeus, or by passing between that muscle and the levator ani. Appearing in the posterior part of the fossa, close to the coccyx, the nerve ends by supplying the external sphincter, and the integuments behind the anus.

supplies
sphincter
and skin.

Offsets of
small
sciatic.

One or two *cutaneous branches* of the *small sciatic nerve* turn round the lower border of the gluteus, in their course to the teguments on its surface.

ANTERIOR HALF OF THE PERINÆAL SPACE.

Contents

In the anterior part of the perinæal space the tube of the urethra is lodged, as it courses from the interior of the pelvis to the surface of the body. Placed about midway between the bones, the tube is supported at first by a fibrous structure named the triangular ligament of the urethra, and afterwards by the body of the penis.

and general
position of
parts.

Muscles are collected around it, to aid in the expulsion of the urine : some of these are superficial to, and some within the triangular ligament mentioned above.

The vessels and nerve lie along the outer side, as in the posterior half, and send inwards offsets.

Incisions to
raise the
skin.

Dissection.—To raise the skin from the anterior part of the perinæum, a transverse cut is to be made at the back of the scrotum, and continued for a short distance (two inches) on each thigh. A second incision along the middle line will allow the flaps of skin to be reflected outwards.

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It has two layers.

The other deeper, but more membranous layer, is of limited extent, and is connected with the firm subjacent structures. On the outer side it is fixed to the pubic arch of the hip bone, external to the line of the crus penis and its muscle, extending as low as the ischial tuberosity. Posteriorly the stratum bends down to join the triangular ligament of the urethra. But in front it is unattached, and is continued to the scrotum and the penis. By means of similar connections on both sides, a pouch is formed over the anterior half of the perineal space underneath the superficial fascia. From the under surface of this layer of the fascia a septum dips downwards in the middle line, and divides posteriorly the subjacent space into two parts; but anteriorly this partition is less perfect or disappears.

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Course of air and effused urine.

Dissection.—The superficial vessels and nerves are to be traced on the right side of the perineum, by cutting through the superficial fascia in the same manner as on the left side.

Dissection of nerves and vessels on right side.

One long slender artery is the superficial perineal, which gives a transverse branch near its commencement: some-

layers of the triangular ligament and will be subsequently seen.

Central point: *Central point of the perinæum* (fig. 70).—Between the urethra and the rectum is a white fibrous spot, to which this term has been applied. It occupies the middle line, being, as the name expresses, nearly in the centre of the perinæum. In it most of the muscles acting on the rectum and the urethra are united; and it serves as a common point of support to the space.

Erector penis. The **ERECTOR PENIS** (fig. 70, c) is the most external of the three muscles; and is narrower at each end than in the middle. It covers the crus penis, and its fibres arise from the inner surface of the ischial tuberosity farther back than the attachment of that part of the penis, and from the bone on each side of the crus. Superiorly the muscle ends in an aponeurosis, and is inserted into the inner and outer surfaces of the crus penis. The muscle rests on the root of the penis and the bone.

Accelerator urinæ. The **ACCELERATOR URINÆ** (fig. 70, b) muscle lies on the urethra in the middle line of the perinæum. The muscles of opposite sides unite through the interposition of a median tendon; and each is attached (its origin) to the tendon along the middle, and to the central point of the perinæum. The fibres are directed outwards, curving around the convexity of the urethra, and give rise to a thin muscle which has the following insertion:—The most posterior fibres are lost on the anterior surface of the triangular

Origin at middle line. ligament. The anterior fibres, which are the longest and best marked, turn round the penis to be inserted on its outer aspect anterior to the erector; and, according to Kobelt,* they send a tendinous expansion over the dorsal vessels of the penis. Whilst the middle or intervening fibres turn round the urethra, passing between the spongy and cavernous bodies of the penis, and join by a tendon the muscle of the opposite side. The accelerator muscle covers the bulb and the urethra for two inches in front of the triangular ligament. If the muscle be cut through on the right side, and turned off the urethra, the junction with its fellow above that tube will be apparent.

Covers the urethra, and surrounds it as in a sling. **Compressor of the bulb.** Some of the deeper fibres which immediately surround the bulb, have been described as a separate stratum by Kobelt. These are separated from the superficial layer by a thin

* Die Männlichen und Weiblichen Wollust-Organen, von G. L. Kobelt 1844.

ligament uniting the bones ; and they are irregular in outline, owing to certain constrictions near the intervertebral foramina. They receive opposite the body of each vertebra the veins from that bone ; and they send outwards, through the intervertebral foramina, branches of communication with the veins outside the spine in the neck, the dorsal region, and the loins and pelvis.

Veins of the bodies of the vertebræ.—Within the canals in the bodies of the vertebræ are large veins : these join on the front of each vertebra with veins in that situation. Towards the back of the bone the veins are united in an arch, from which two trunks, one for each side, issue by the large apertures on the posterior surface. Escaped from the bone, the trunks diverge,—one to the right another to the left, and open into the large longitudinal veins.

The *posterior spinal veins* form a plexus between the dura mater and the arches of the vertebræ. A large vein may be said to lie on each side of the middle line, which joins freely with its fellow, and with the anterior longitudinal vein by lateral branches. Into this plexus the small veins on the outside of the neural arches pour their contents. Branches from these vessels are directed to the intervertebral foramina, where they end in the veins at the roots of the transverse processes.

- Extent and form.** form, with its base below ; and it is about one inch and a half in depth. On the sides it is fixed to the pubic arch beneath the crura penis. Its apex is connected with the symphysis pubis. Its base is turned towards the rectum, and is partly attached and partly free :—In the middle line it is connected with the central point of the perinæum, whilst laterally it is sloped towards the bone, so that it is less deep at the centre than at the sides : connected with the lower border, is a thin fascia which covers the surface of the levator ani muscle in the ischio-rectal fossa.
- Attachments.**
- Parts over it.** Superficial to it are the muscles in the anterior half of the perinæal space, and the superficial fascia is united to it near the lower border. Perforating the fore part of the ligament about one inch below the symphysis pubis is the canal of the urethra ; but the margin of the opening giving passage to the tube is blended with the tissue of the corpus spongiosum urethræ. About midway between the preceding opening and the symphysis pubis is the aperture for the dorsal vein of the penis ; and external to it, near the bone on each side, the terminal parts of the pudic nerve and artery to the penis perforate the ligament.
- Apertures in it for urethra,**
- for dorsal vein and vessels and nerves.**
- Consists of strata.** The triangular ligament is composed of two layers of fibrous membrane (anterior and posterior) which are united below, and protect the membranous part of the urethra. The posterior layer is derived from the pelvic fascia. The anterior is a separate structure, and consists chiefly of transverse fibres, but it is so thin as to allow the vessels and the muscular fibres to be seen through it. Between the layers of the ligament are the membranous part of the urethra, with its muscles, vessels and glands ; also the bloodvessels and nerves of the penis, as the subsequent dissection will show.
- Parts between.**
- Dissection.** *Dissection.*—The muscles of the urethra between the layers of the ligament will be reached by cutting through with care, on the left side, the superficial stratum of the ligament near its attachment to the bone, and raising and turning inwards that piece of membrane. By a little cautious dissection, and the removal of some veins, the following objects will come into view with the under-mentioned position :—
- Parts in the triangular ligament.** *Parts between the layers of the ligament.*—Near the base of the ligament is a narrow transverse muscle, which is directed to the bulb of the urethra. Crossing inwards to the urethra, from behind the pubic arch, is the fasciculus of fibres of the compressor urethræ muscle, which surrounds

the membranous part of the urethra. And below the urethra are the glands of Cowper. Beneath the bone (pubic arch) are the pudic vessels and nerve, the former giving its branch to the bulb; and below the pubes is the subpubic ligament. Deeper than all, the student will be able to recognise the posterior layer of the ligament, continuous with the pelvic fascia, which separates these parts from the cavity of the pelvis.

MUSCLES.—The muscles between the layers of the triangular ligament, which are connected with the membranous part of the urethra, are two in number, viz. a deep transverse muscle, and a constrictor of the urethral passage.

The **DEEP TRANSVERSE** muscle of the perineum (elevator urethrae, Santorini) is a thin flat band, on a level with the base of the triangular ligament. It *arises* externally from the pubic arch of the innominate bone, and is directed inwards below the tip of the bulb and the membranous part of the urethra to the middle line, where it joins (sometimes by a tendon) the muscle of the opposite side, and is inserted into the central point of the perineum. The muscle conceals Cowper's gland, and is frequently placed over the artery of the bulb. The transverse muscle is not always separate from the following.

The **CONSTRUCTOR MUSCLE** (constrictor isthmi urethralis) encloses the membranous part of the urethra (fig. 71). It consists of transverse fibres, both above and below the urethral tube, which are connected on each side to the pubic arch.

The muscle *arises* by aponeurotic fibres from the pubic arch above the preceding, but this attachment is not evident unless the muscle has been dissected from behind. From this origin the fibres pass inwards, and separate near the urethra into two layers, of which one (Fig. 71, 7) passes over, the other (8) under that canal; in the middle line they unite, sometimes by tendinous bands, with the like parts of the muscle of the opposite side.

It may be described as a single muscle extending across the perineum from one lateral attachment to the other, and enclosing the tube of the urethra, like the sphincter ani encircles the rectum.*

* Further information respecting this muscle may be obtained in the Septemdecim Tabulae of Santorini; in a Paper by Mr. James Wilson, in the first volume of the Med. Chirur. Transactions; in the Work of Mr. Guthrie, On the Anatomy and Diseases of the Neck of the Bladder and Urethra; and in the Treatise of J. Müller, Ueber die Organischen Nerven der erectilen Männlichen Geschlechts-Organen, &c.

Circular
fibres of
urethra,

Involuntary circular fibres surround the urethra from the bulb to the prostate within the constrictor muscle, and form a layer about $\frac{1}{30}$ th of an inch thick ; they are not fixed to bone, and are continuous behind with the circular fibres of

Fig. 71.*



from the
prostate to
bulb,

the prostate and bladder. This layer is described commonly as part of the constrictor, but its fibres are not transversely striated as in that muscle. It is only a portion of the large involuntary orbicular muscle, of which the prostate is part, surrounding the beginning of the urethra.†

Cowper's
gland.

The *glands of Cowper* will be found by cutting through the transverse muscle. They are situate below the membranous part of the urethra, one on each side of the middle line, and close behind the bulb.

Situation,
size, and
structure.

Each gland is about the size of a pea, and is made up of many lobules ; and the lobules are composed of small vesicles, which are lined by flattened epithelium. Connected with each is a minute duct, nearly an inch in length, which perforates obliquely the wall of the urethra (*corpus spongiosum*), and opens into the urethral canal about half an

Length and
termination
of the duct.

* The symphysis pubis seen from behind with part of the urinary bladder and the tube of the urethra surrounded by the constrictor muscle (Santorini). 1. Symphysis pubis. 2. Sawn hip bone. 3. Internal obturator muscle. 4. Urethra. 5. The triangular part of the bladder seen from within. 6. Prostate gland. 7. Stratum of the constrictor above the urethra. 8. Stratum below the urethra.

† See a Paper on the Arrangement of the Muscular Fibres of the Urethra, &c., in vol. xxxix. 1856, of the Trans. of the Med. Chir. Society.

inch in front of the triangular ligament. Its aperture in the ordinary state of the parts does not admit a bristle. In the wall of the duct are unstriated muscular fibres; and the interior is lined by a columnar epithelium. The secretion of the duct is "ordinary mucus."—(Kölliker.)

These bodies are sometimes so small as to escape detection, and they appear to decrease in size with advancing age. They vary in size.

Dissection.—The student may complete the examination of the perinæum by tracing out the pudic vessels and nerve, and their remaining branches. From the point of its division into two branches (dorsal branch of the penis, and branch of the corpus cavernosum) beneath the crus, the artery is to be followed backwards, along the outer wall of the right ischio-rectal fossa. The pudic nerve will be exposed at the same time, and should any of the branches be cut away, the corresponding ones may be sought on the opposite side. Dissection of the pudic vessels and nerve.

The PUDIC ARTERY is a branch of the internal iliac. It enters the perinæal space through the small sacro-ischiatic notch; and distributing offsets to the perinæum, it ends in the genital organs. Entering the posterior part of the ischio-rectal fossa, the artery extends forwards along the outer wall about one inch and a half above the ischial tuberosity, and is contained in an aponeurotic canal which attaches it to the fascia covering the obturator muscle; but towards the base of the triangular ligament the vessel is placed much nearer the margin of the pubic arch. It then ascends between the layers of the triangular ligament and along the pubic arch nearly to the subpubic ligament, where it perforates the superficial part of the triangular ligament, and divides into the arteries of the body and dorsum of the penis. Pudic artery courses along pubic arch and ends on penis.

The branches of the vessel in the perinæal space are numerous. The superficial offsets, viz. inferior hæmorrhoidal, transverse perinæal, and superficial perinæal, have been examined (p. 462); the remaining, for the supply of the penis and the urethra, are subjoined:— Branches not yet seen are:

a. The artery of the bulb of the urethra is a branch of considerable size, and arises near the base of the triangular ligament. Passing almost transversely inwards between the layers of the ligament, and about half an inch from its base, the artery reaches the bulb of the urethra, and enters the spongy structure. Near the urethra it furnishes a small branch to Cowper's gland. Artery of bulb in the triangular ligament.

The distance of this branch from the base of the ligament its situation varies.

- will be influenced by its origin nearer the front or back of the perineal space. If the vessel arises farther behind than usual, it may be altogether below the base of the ligament, and cross the front of the ischio-rectal fossa; but if it arises more anteriorly, as when it comes from an accessory pudic branch (see below), its position will be higher than the level of the bulb. In the case first mentioned, it would be liable to be cut across, whilst in the last it would be altogether out of the way of the knife. From the size of the vessel its position is important in the operation of lithotomy.
- The importance of this in lithotomy.
- Artery of body of penis.
- Artery of dorsum of penis.
- Accessory pudic artery, source.
- Pudic vein.
- Pudic nerve is with the artery
- and ends like it on penis.
- Perineal branch
- b. The artery of the cavernous structure of the penis* (art. corporis cavernosi) is one of the terminal branches of the pudic. At first this small vessel lies between the crus penis and the bone, but it soon enters the cavernous structure, and ramifies in it.
- c. The dorsal artery of the penis* is in direction and size the continuation of the pudic; it runs upwards like the preceding between the crus and the bone, and reaches the dorsum of the penis by passing through the suspensory ligament. Its distribution with the accompanying nerve is noticed at page 481. It is much smaller in the female than in the male.
- Accessory pudic artery.*—In some cases the pudic artery is not large enough to supply all the branches above described to the penis and the urethra. One or more offsets will be then contributed by an accessory vessel, which leaves the pelvis in front by piercing the triangular ligament. The source of this accessory artery is the internal iliac.
- The *pudic vein* has the same connections as the artery; it has also similar branches, except that the dorsal vein of the penis does not join it.
- The **PUDIC NERVE** is derived from the sacral plexus, and distributing offsets with the branches of the pudic artery, ends in the penis. Accompanying the bloodvessels, the nerve enters the posterior part of the ischio-rectal fossa, and supplies there the inferior hæmorrhoidal (p. 459), and a large perineal branch. Much diminished in size, it continues with the artery without branching, pierces the triangular ligament of the urethra near the pubes, and is continued onwards to the dorsum of the penis with the dorsal branch of the pudic artery; its termination is described at page 482. The following are its offsets:—
- a. The perineal branch* is distributed to the perineum. It supplies first the superficial perineal nerves, which have been already seen (p. 462), and extends forwards below the

pudic artery, nearly to the base of the triangular ligament, where it ends in offsets to the muscles, and to the bulb of the urethra. ends in the following.

b. Muscular branches.—One turns outwards to enter the under surface of the erector penis; others pass beneath the transversalis, supplying it and the accelerator urinæ; and one or two other slender filaments pierce the triangular ligament, and supply the muscles beneath it. Muscular offsets.

c. The nerve of the bulb is a long slender branch which supplies, like the artery, the spongy structure investing the canal of the urethra. Some of its filaments reach some way on the surface before entering the corpus spongiosum urethræ. Nerve of the bulb.

Parts cut in the lateral operation of lithotomy.—In making the external incision the knife is entered in the middle line of the perinæum, one inch in front of the anus, and is drawn backwards on the left side to midway between the ischial tuberosity and the anus. The skin and the superficial fascia, and the inferior hæmorrhoidal vessels and nerve lying across the ischio-rectal fossa would be cut in the first step of the operation; and the transverse perinæal muscle and artery, and, possibly, the superficial perinæal vessels and nerves may be divided at the same time. Superficial parts cut in lithotomy.

In the subsequent attempt to reach the staff, when the knife is introduced into the anterior part of the wound, the lower part of the triangular ligament, the deep transverse urethral muscle, and the fore part of the levator ani will be divided; and when the knife is placed within the groove of the staff, the membranous part of the urethra will be cut, with the muscular fibre about it. in reaching the staff

Lastly, as the knife is pushed along the staff into the bladder, it incises in its progress the membranous division of the urethra, and part of the prostate with the large veins around it. and in running knife along staff.

Parts to be avoided.—In the first incisions in the ischio-rectal fossa, the rectum may be cut if the knife is turned inwards across the intestine, instead of being kept parallel with it, and if the gut is not kept out of the way with the fore finger of the left hand. The pudic vessels on the outer wall of the ischio-rectal fossa may be wounded near the anterior part of the hollow, where they approach the margin of the triangular ligament; but, posteriorly, they are very securely lodged inside the projection of the tuber ischii. Parts to be avoided are rectum, pudic vessels,

Whilst making the deeper incisions to reach the staff, the bulb and its artery lie immediately in front of the knife, and will be wounded if the incisions are made too far bulb and its artery.

forwards ; but the artery must necessarily be cut, when it arises farther back than usual, and crosses the front of the ischio-rectal fossa in its course to the bulb of the urethra.

ejaculatory
duct, and

In dividing the prostate gland the edge of the knife is to be turned outwards and downwards, in the direction of a line from the urethra through the left lateral lobe of that body, and so as not to injure the ejaculatory duct below.

capsule of
the prostate
gland.

The upper part of the prostate and its fibrous capsule are not to be cut through, otherwise the vessels on the exterior may be divided, and the urine may be effused beneath the peritoneum.

Directions.

Directions.—When the dissection of the perineum is completed, the flaps of skin are to be fastened together after some preservative fluid has been used, and the limbs are to be put down into the position required for the examination of the abdomen.

SECTION II.

PERINEUM OF THE FEMALE.

Perineum
of female

The perineum in the female differs from that in the male more in the external form than the internal anatomy ; but it has special parts distinguishing it, viz. the aperture of the vagina surrounded by its sphincter, and the aperture of the vulva with the labia.

Along
middle aper-
tures of
anus and
vulva.

Surface-marking.—On the surface of the perineal space in the middle line, there are the two apertures of the anus and vulva, which are separated from one another by an interval of about an inch. The anus is situate relatively rather farther back than in the male. And the vulva is in the situation of the scrotum of the other sex, with the labia majora on the sides. Within the vulva at the upper part, is the clitoris, with two small membranous folds, labia minora, extending downwards from it. Below the clitoris is the small aperture of the urethra ; and still lower down is the vagina, whose opening is sometimes partly closed by a thin piece of membrane, the hymen.

Parts within
vulva.

Parts
bounding
space are
alike in both
sexes.

Deep boundaries.—The deep boundaries of the perineum are alike in both sexes ; but in the female the outlet of the pelvis, corresponding with the perineum, is larger than in the male.

Dissection.—The steps of the dissection are much the

same in both sexes, and the same description will serve, generally, for the perinæum of both the male and the female.

First, the dissection of the ischio-rectal fossa is to be made ; and afterwards the muscles, vessels, and nerves of the posterior half of the perinæal space are to be examined. (See description of the male perinæum, p. 455.)

Next the skin is to be taken from the anterior half of the perinæal space, as in the male ; and the transverse incision in front is to be made at the anterior part of the vulva. The attachments of the superficial fascia are then to be looked to, and the cutaneous vessels and nerves are to be traced beneath it (p. 460).

Superficial fascia.—The description of this fascia in the male will serve for the like part in the female with these modifications ; that in the female it is less perfect and of less extent, in consequence of the aperture of the vulva ; and that it is continued forwards through the labia majora (the representative of the scrotum) to the inguinal region.

Dissection.—The labia and the superficial fascia are to be removed, to follow the sphincter muscle around the opening of the vagina. The two other muscles that are exposed at the same time (transversalis perinæi and erector clitoridis) resemble those in the male.

The SPHINCTER VAGINÆ is an orbicular muscle around the orifice of the vagina, and corresponds with the ejaculator urinæ in the male. Posteriorly it is attached to the central point of the perinæum, where it mixes with the sphincter ani and transversalis muscles ; and its fibres are directed forwards on each side of the vagina, to be inserted into the body of the clitoris.

The ERECTOR CLITORIDIS resembles the erector of the penis in the male, though it is much smaller.

The TRANSVERSALIS is similar to the muscle of the same name in the male. The one description will suffice for it in both sexes (p. 465).

Dissection.—To see the triangular ligament of the urethra, the erector and the crus clitoridis are to be detached from the bone, and the outer fibres of the sphincter vaginæ are to be removed.

The *triangular ligament* transmits the urethra, but is not quite so strongly marked as in the male ; its extent is partly interrupted behind by the large aperture of the vagina.

Dissection.—By cutting through the superficial layer of

Take first ischio-rectal fossa.

Then examine anterior half of perinæum.

Superficial fascia.

Dissection of the muscles.

Sphincter vaginæ.

Origina.

Insertion.

Erector clitoridis.

Transversalis.

To expose triangular ligament.

Triangular ligament.

To see

muscles of urethra. the ligament in the same way as in the male, the deep muscles, with the pudic vessels and nerve, and their branches, will be arrived at. Afterwards the trunks of the vessels, and the pudic nerve, are to be traced backwards.

Deep transverse muscle. The DEEP TRANSVERSE MUSCLE (depressor urethræ, Santorini) has the same origin externally as in the male, and it meets its fellow at the middle line, like the muscle answering to it in the other sex. Santorini described the muscle as passing over, instead of below the urethra; hence the name given to it by its discoverer.

Constrictor urethræ. The CONSTRICTOR MUSCLE of the urethra resembles that of the male in its origin from the pubes, and its disposition around the urethra. Within it is also a circular layer of involuntary fibres, as in the other sex.

Pudic vessels. The description of the *pudic artery* (p. 469) will serve for both sexes, except that the branch in the female, which is the representative of the artery of the bulb in the male, is furnished to the vagina. The terminal branches are much smaller in the female.

Pudic nerve. The *pudic nerve* has the same peculiarity as the artery with respect to the branch to the vagina, and the smaller size of the terminal part of the nerve on the clitoris.

CHAPTER VIII.

DISSECTION OF THE ABDOMEN.

SECTION I.

WALL OF THE ABDOMEN.

THE dissector may be reminded that the perinæum is allotted to him with the abdomen. And he is to keep in mind that he has not only to examine that region, but to proceed as far in the description of the abdomen as the end of Section III. before the body is turned for the dissection of the back.

Directions
for the
dissection.

Position.—The body will be sufficiently raised by the blocks placed beneath the thorax and head according to the directions given in the dissection of the upper limbs and neck, but the dissector should see that the chest is higher than the pelvis. After the abdomen has been inflated by an aperture through the umbilicus, let the markings on the surface be first attended to.

Position of
the body.

Surface-marking.—On its anterior aspect the abdomen is for the most part convex, especially in fat bodies ; whilst on the sides, between the ribs and the crista ilii, the surface is somewhat depressed. Along the middle line is a slight groove over the linea alba, which presents about its centre the excavation of the umbilicus. Inferiorly the groove ceases a little above the pelvis in the prominence of the pubes ; and superiorly it subsides below the ensiform cartilage in a hollow named the epigastric fossa. On each side of the middle line is the projection of the rectus muscle, and this is intersected in young and well-formed bodies by two or three transverse depressions.

Appear-
ances on the
front of the
abdomen.

Underneath the eminence of the pubes the student will be able to recognise with his finger the symphysis pubis, and to trace outwards from it the contiguous pubic crest of bone which leads to the pubic spinous process. If the finger is carried still outwards to the crest of the innominate bone,

Projection
of the pubes

and Fou-
part's liga-
ment.

it will detect the firm band of Poupart's ligament, and sometimes a few inguinal glands.

Abdominal
rings.

Rather above and to the outside of the pubes, the opening of the external abdominal ring may be felt, and the prominence of the spermatic cord descending through it to the testicle may be perceived. The internal abdominal ring is still to the outer side, though it cannot be recognised usually on the surface by the finger ; but its position may be ascertained by taking a point midway between the symphysis pubis and the crest of the innominate bone, and a little above Poupart's ligament.

Penis and
scrotum.

Attached to the front of the symphysis pubis in the male are the penis and the scrotum.

Raise the
skin from
the front.

Dissection.—The requisite incisions for raising the skin from the sides and front of the belly are the following :— One cut is to extend outwards over the side of the chest from the ensiform cartilage to about midway between the sternum and the spine, if this has not been made already by the dissector of the upper limb. A second incision is to be begun in the middle line midway between the umbilicus and the pubes, and to be carried outwards to the iliac crest, and along the crest till it ends opposite the first cut ; lastly, the hinder extremities of the two incisions are to be connected along the side of the chest and the belly. The piece of skin thus marked out is to be raised towards the middle line, and the cutaneous vessels and nerves are to be sought in the fat at the side and middle line of the abdomen.

Position of
cutaneous
nerves,

on the side :

Along the side of the abdomen are the lateral cutaneous nerves, five or six in number, which will be found in a line with the corresponding nerves of the thorax ; offsets are to be traced forwards and backwards with small cutaneous arteries. On the iliac crest, near the front, is a large branch from the last dorsal nerve ; and still farther back on the crest, is a smaller cutaneous branch of the ilio-hypogastric nerve.

and in front.

Near the middle line, the small anterior cutaneous nerves will be recognised ; these are uncertain in number and size, and are to be followed outwards in the integuments.

Take the
skin from
the groin.

The piece of skin covering the lower part of the abdomen or the groin is next to be thrown downwards, on both sides, by means of an incision along the middle line to the root of the penis. After its reflection the cutaneous vessels and nerves are to be dissected on the right side, and the superficial fascia on the left.

Seek vessels

To make the necessary dissection on the right side, all the

fascia superficial to the vessels is to be raised in the same manner as the piece of skin. The vessels which will then appear are the superficial pudic on the inside, the superficial epigastric in the centre, and an offset of the superficial circumflex iliac artery on the outside. Some inguinal glands are seen along the line of the reflected fascia. Two cutaneous nerves are to be sought:—one, the ilio-inguinal, comes through the abdominal ring, and descends to the thigh; the other, ilio-hypogastric, appears in the superficial fascia above, and rather outside the abdominal ring.

and nerves
in right
groin.

In the dissection of the fascia on the left side two strata or layers are to be made out, one over and one beneath the vessels. The layer that is superficial to the vessels is to be reflected by means of a transverse cut from the front of the iliac crest to the middle line, not much above Poupart's ligament; and by a vertical one along the middle line to the pubes. The subjacent vessels mark the depth of this layer; and when these are reached, a flap of the fascia like that of the skin, is to be thrown towards the thigh. To define the thinner under stratum, cut it across in the same manner as the other layer, and then detach it with the vessels on it from the tendon of the external oblique muscle. This stratum, like the preceding, is to be traced around the cord to the scrotum; and as the student follows it downwards, he will find it connected with Poupart's ligament, and inseparably joined with the fascia lata close below that structure.

Separate
superficial
fascia into
layers in
left groin.

The *superficial fascia*, or the subcutaneous fatty layer, lies between the skin and the special fascia investing the muscles, and is indivisible over the greater part of the abdomen; but in the groin it is divided into a subcutaneous and a deeper layer by the vessels and the glands.

Superficial
fascia
is divided
into two
layers.

The *subcutaneous layer* contains fat, and varies therefore in appearance and thickness in different bodies; for it is sometimes divisible into strata, whilst at others it is very thin and somewhat membranous near the thigh. This layer is continuous with the cutaneous fatty covering of the thigh, and with that of the rest of the abdomen; and when traced to the limb, it is found to be separated from Poupart's ligament beneath by the superficial vessels and glands. Internally it is continued to the penis and the scrotum, where it changes its adipose tissue for involuntary muscular fibre; and after investing the testicle, the layer is prolonged to the superficial fascia of the perineum.

The subcutaneous layer contains fat,

except in
the penis
and scrotum.

The *deeper layer* of the superficial fascia (aponeurosis of Deeper

layer is thin and membranous. the fascia lata, Scarpa) is thinner and more membranous than the other, and is closely united to the tendon of the external oblique by fibrous bands, especially towards the linea alba. Like the subcutaneous part of the fascia, this layer is continued upwards on the abdomen, and inwards to the penis and the scrotum : in this last part it becomes very thin, and, having passed through the scrotum, reaches the perinæum, where it has attachments to the subjacent parts as before specified (p. 461). Towards the top of the limb it extends only a very short distance, and ends a little below Poupart's ligament by joining the fascia lata across the front of the thigh ; as it passes over the ligament it is closely joined to that band by a thin membrane.

Special characters and disposition,

and ends on fascia lata.

Attachments determine course of effused urine.

Fascia in the female.

Cutaneous nerves

are derived from two sources.

Lateral cutaneous of the intercostal,

which divide into

posterior and

Should urine be effused from rupture of the urethra, it will be directed through the scrotum, by reason of the attachments of the superficial fascia in the perinæum, and upwards along the spermatic cord to the abdomen. From the disposition of the deeper layer across the thigh, it is evident that the fluid cannot pass down the limb, though its progress over the front of the abdomen is uninterrupted.

In the female the superficial fascia of the groin is separable into two layers, and the disposition of each is nearly the same as in the male ; but the part that is continued to the scrotum in the one sex, enters the labium in the other in its course to the perinæum. In the female the round ligament of the uterus is lost in the superficial fascia of the groin.

CUTANEOUS NERVES.—The nerves in the superficial fascia are derived chiefly from the trunks of the lower intercostal nerves ; thus the lateral cutaneous branches along the side of the belly are offsets from five or six of those nerves, whilst the anterior cutaneous branches along the front are the terminal parts of the same trunks. Two other cutaneous offsets from the lumbar plexus, viz., the ilio-hypogastric and ilio-inguinal, appear at the lower part of the abdomen.

The *lateral cutaneous nerves* of the abdomen emerge between the digitations of the external oblique muscle, in a line with the same set of nerves on the thorax ; and the lowest are the most posterior. As soon as they appear on the surface they divide, with the exception of the last, into an anterior and a posterior branch.

a. The *posterior branches* are small in size, and are directed backwards to the integuments over the latissimus dorsi muscle.

b. The *anterior branches* run forwards in the superficial

fascia nearly to the edge of the rectus muscle, and supply the integuments on the side of the belly; they furnish offsets to the digitations of the external oblique muscle.

anterior branch.

The *lateral cutaneous branch* of the *last dorsal nerve* is larger than the rest, and does not divide like the others. After piercing the fibres of the external oblique muscle, it is directed over the iliac crest to the surface of the gluteal region.

Last dorsal nerve.

The *anterior cutaneous nerves* of the abdomen reach the surface by piercing the sheath of the rectus: in the integuments they bend outwards towards the lateral cutaneous nerves. The number, and the place of exit of these small nerves from the abdominal wall, are very uncertain.

Anterior cutaneous nerves of intercostal.

The *ilio-hypogastric nerve* is distributed on the surface by two pieces: one lies over the crista ilii (*iliac branch*), the other ramifies on the lower part of the abdomen (*hypogastric branch*).

Ilio-hypogastric of lumbar plexus.

a. The *iliac branch* is close to the crest of the hip bone behind the last dorsal nerve, and enters the integuments of the gluteal region: its size and its position on the bone are dependent upon the development and the situation of the offset of the last dorsal nerve.

Iliac branch.

b. The *hypogastric branch* pierces the aponeurosis of the external oblique muscle above the external abdominal ring, and is distributed, as the name expresses, to the integuments of the lower part of the abdominal parietes.

Hypogastric branch.

The *ilio-inguinal nerve* becomes cutaneous through the external abdominal ring, and having perforated the deeper layer of the superficial fascia, descends to the integuments of the scrotum and upper and inner part of the thigh.

Ilio-inguinal nerve of the plexus.

CUTANEOUS VESSELS.—Some cutaneous vessels are found with both sets of nerves on the abdomen:—with the lateral cutaneous nerves are branches from the intercostal arteries, and with the anterior cutaneous are offsets from the internal mammary and epigastric vessels. In the groin are three small superficial branches of the femoral artery, viz., pudic, epigastric, and circumflex iliac.

Vessels from two sources.

The *lateral cutaneous arteries* have the same distribution as the nerves they accompany. The anterior or chief offsets are directed towards the front of the abdomen, and end about the outer edge of the rectus muscle.

Both lateral

The *anterior cutaneous vessels* are irregular in number and in position, like the nerves. After piercing the sheath of the rectus, they run outwards with the nerves towards the other set of branches.

and anterior cutaneous.

From
femoral
artery three
branches.

Branches of the femoral artery.—Three cutaneous offsets ascend from the thigh between the layers of the superficial fascia, and ramify in the integuments of the genital organs and lower part of the abdomen. The greater portion of these vessels appears in the dissection of the thigh.

External
pudic.

a. The *external pudic branch* (superficial) crosses the spermatic cord, to which it gives offsets, and ends in the integuments of the under part of the penis.

Superficial
epigastric.

b. The *superficial epigastric branch* ascends over Poupart's ligament, near the centre, and is distributed in the superficial fascia nearly as high as the umbilicus. Its size varies very much.

Circumflex
iliac.

c. The *circumflex iliac branch* lies usually below the level of the iliac crest, and sends only a few offsets upwards to the abdomen.

Veins.

Small *veins* accompany the arteries, and join the internal saphenous vein of the thigh.

Inguinal
glands.

The *glands of the groin* are three or four in number, and lie over the line of Poupart's ligament. They are placed between the strata of the superficial fascia, and receive the lymphatics from the abdomen, from the upper and outer part of the thigh, and from the superficial parts of the genital organs. Their efferent ducts pass downwards to the saphenous opening in the thigh to enter the abdomen.

Ducts enter
thigh.

Dissection
of coverings
of penis.

Dissection.—After the examination of the superficial fascia with its vessels and nerves on the abdomen, the student may make the dissection of the cutaneous coverings of the penis and scrotum. The skin may be divided along the dorsum of the penis, and thrown to each side; and the skin of the scrotum is to be reflected afterwards by means of a vertical incision on the left side.

Tegumen-
tary cover-
ing of penis

Cutaneous coverings of the penis and scrotum.—The penis is attached to the front of the pubes by a suspensory ligament, and is provided with a tegumentary covering with vessels and nerves.

is thin, and
without fat:

On the *penis* the tegumentary covering is continuous with that of the abdomen, but the superficial fascia loses the fat it possesses in most other parts of the body, and acquires special characters. Around the end of the penis it forms the loose sheath of the prepuce in the following way:—When the skin has reached the extremity, it is reflected backwards as far as the base of the glans, constituting thus a double sheath—the *prepuce*; it is afterwards continued over the glans, and joins the mucous membrane of the urethra at the orifice on the surface. At the under part of the glans, and

forms
prepuce

behind the aperture of the urethra, the integument forms a small triangular fold, *frænum præputii*. Where the integument covers the glans it is very thin, assuming in some cases the characters of a mucous membrane ; and behind the glans are some sebaceous follicles—*glandula odorifera*.

In the scrotum.—The superficial fascia becomes thin, and of a reddish colour in the scrotum. If it is cut through the student will perceive that the prolongation sent around the cord on one side, does not communicate with that on the other side; and that the two pouches come in contact in the middle line, and form the septum scroti.

The superficial fascia in the scrotum and penis, and in the front of the perinæum contains involuntary muscular fibres, to which the corrugation of the skin is owing. This contractile structure is named the *tunica dartos*.

Dissection.—By removing the fatty tissue from the root of the penis and the front of the symphysis pubis, the suspensory ligament will be defined. And the dorsal arteries and nerves, and the vein of the penis, which will be partly laid bare, are to be followed forwards in the superficial fascia.

The *suspensory ligament of the penis* is a rather deep band of fibrous tissue, of a triangular form, which is attached by its apex to the front of the symphysis pubis near the lower part. Widening as it descends, the ligament is divided into two pieces, which are fixed to the upper surface of the body of the penis, and are prolonged on it for some distance. In the interval between the pieces or layers are the dorsal vessels and nerves of the penis.

Dorsal vessels and nerves.—The arteries and nerves on the dorsum of the penis, are the terminal parts of the pudic trunks of both sides. The vein accompanying the arteries enters the front of the pelvis through the triangular perinæal ligament.

The *dorsal artery*, one on each side, appears between the layers of the suspensory ligament, and extends forwards to the glans, where it ends in many branches for that structure ; in its course the artery supplies the integuments and the body of the penis. It may be derived from the accessory pudic (p. 470).

The *dorsal vein* is a single trunk, and commences by numerous branches from the prepuce and the glans penis. The course of the vein is backwards by the side of the artery, between the layers of the suspensory ligament, and then through the triangular ligament of the urethra, to join the

prostatic plexus of veins. The vein receives branches from the erectile structure of the penis.

Dorsal nerve of pudic. Each *dorsal nerve* takes the same course as the artery, and ends like it in numerous branches to the glans penis. It furnishes a large branch to the corpus cavernosum penis, and other offsets to the integuments of the dorsum, the sides, and the prepuce of the penis.

Vessels on clitoris. In the female these vessels are much smaller than in the male; they occupy the upper surface of the clitoris—the organ that represents the penis.

To expose external oblique muscle. *Dissection of the muscles.*—The surface of the external muscle of the abdominal wall is next to be freed from fascia on both sides of the body.

It is not advisable to begin cleaning this muscle in front, because there it has only a thin aponeurosis, which is taken away too readily with the fat: behind, however, the muscle is thick and fleshy, and cannot well be injured. Whilst beginning the dissection at the posterior part, the student is to carry the knife obliquely upwards and downwards in the direction of the fibres. The thin aponeurosis before referred to is in front of a line extended upwards from the anterior part of the iliac crest; and as the dissector approaches that spot, he must be more careful not to injure it, more particularly at the upper part where it lies on the margin of the ribs.

To define abdominal ring. On the right side the margin of the external abdominal ring may be defined to show the cord passing through it; and on the left side a thin fascia (intercolumnar), which is connected with the margin of that opening, is to be preserved. Lastly, the dissector should make evident the free margin of the external oblique muscle between the last rib and the iliac crest.

On the side are three flat muscles. **MUSCLES OF THE ABDOMINAL WALL.**—On the side of the abdomen are three large flat muscles, which are named from their position to one another, and from the direction of their fibres. The most superficial muscle is the external oblique, the one underneath the internal oblique, and the deepest is the transversalis.

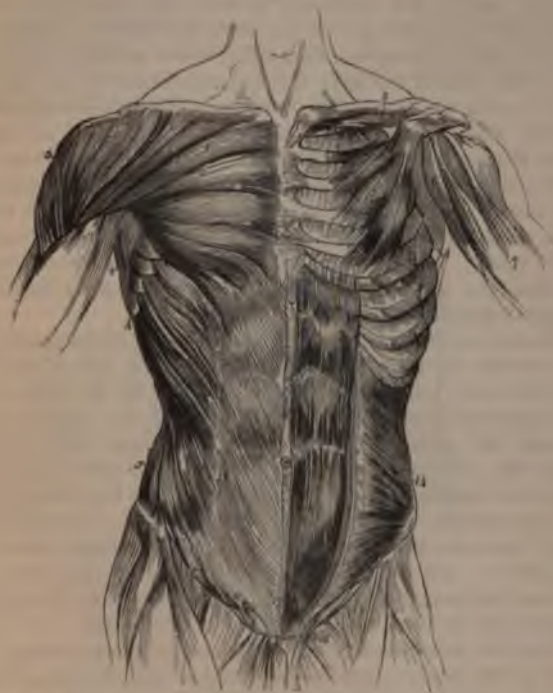
and their aponeuroses incase three vertical muscles. Along the middle line the muscles have a vertical direction. In front are the rectus and pyramidalis, and behind the quadratus lumborum; these are incased by sheaths derived from the aponeuroses of the lateral muscles.

External oblique muscle. The **EXTERNAL OBLIQUE MUSCLE** (fig. 72ⁿ) is fleshy on the side, and aponeurotic on the fore part of the abdomen. It arises by fleshy points or digitations from the eight lower

ribs ; and the five highest pieces which are attached to the outer surface and lower border of each rib, alternate with similar parts of the serratus magnus ; whilst the lowest three, connected with the lower margins of the ribs, digitate

Origin from ribs.

Fig. .72*



with the processes of origin of the latissimus dorsi muscle. From the attachment to the ribs, the fibres are directed over the side of the abdomen in the following manner :—the lower

* Superficial muscles of the abdomen and thorax on the right half of the figure, and the deep muscles on the left half. 1. Pectoralis major. 2. Pectoralis minor. 3. Subclavius. 4. Serratus magnus. 5. Deltoid. 6. Coraco-brachialis. 7. Biceps brachii. 8. Latissimus dorsi. 9. External oblique of abdomen, with 10, external abdominal ring ; and 11, Ponpart's ligament. 12. Linea alba. 13. Aponeurosis of external oblique. 14. Internal oblique muscle. 15. Cremaster muscle on the spermatic cord. 16. Rectus muscle. 17. Pyramidalis abdominis.

Insertion
into pelvis
and linea
alba.

Aponeurosis
covers front
of the belly.

Disposition
above and
below.

Con-
nec-
tions.

Lines on
the aponeu-
rosis.

Apertures
in it.

Abdominal
ring.

In the linea
alba the
aponeuroses
are united.

In its middle
is umbilicus.

fibres descend almost vertically to be *inserted* into the anterior half or more of the iliac crest, at the outer margin : and the upper and middle fibres are continued forwards, the one set horizontally, the other obliquely, to the aponeurosis on the front of the belly.

The *aponeurosis* of the muscle (Fig. 72¹⁵) occupies the anterior part of the abdomen, in front of a line from the eighth rib to the fore part of the crista ilii ; and it is rather narrower about the centre, than either above or below. Along the middle line of the body this expansion ends in the linea alba (¹²)—the common point of union of the aponeuroses of opposite sides. Above, it is thin, and is continued on the rectus muscle to the pectoralis major and the ribs. Below, the fibres of the aponeurosis are stronger and more separate than above, and are directed obliquely downwards and inwards to the pelvis : some of them are fixed to the front of the pubes ; and the rest are collected into a firm band between the pubes and the iliac crest, which is named Poupart's ligament.

Connections of the muscle.—The muscle is subcutaneous. Its posterior border is unattached between the last rib and the iliac crest, but it is overlaid commonly by the edge of the latissimus dorsi, except a small part below. Appearing through the aponeurosis, external to the linea alba, is a white line, the linea semilunaris, marking the outer edge of the rectus muscle ; and crossing between the two are three or four whitish marks, the lineæ transversæ. Numerous small apertures in the tendon give exit to cutaneous vessels and nerves ; and near the pubes is the large opening of the external abdominal ring (¹⁰), which gives passage to the cord in the male, and the round ligament in the female.

PARTS OF THE APONEUROSIS.—Besides the general arrangement of the aponeurosis over the front of the abdomen, the student is to examine more minutely the linea alba in the middle line ; the external abdominal ring with the fascia prolonged from its margin ; and the rounded border named Poupart's ligament.

Linea alba (fig. 72, ¹²).—This is the central line of union of the aponeuroses of opposite sides on the front of the abdomen. It extends from the xiphoid cartilage to the pubes, and serves as a ligament between the chest and pelvis. Its breadth is wider above than below, and it is perforated here and there by small apertures, which allow masses of fat to protrude in some bodies. A little below the centre is the umbilicus ; this projects now beyond the

surface, though before the skin was removed there was a hollow over it. At this spot a piece of intestine may protrude from the abdomen.

External abdominal ring.—This is an opening (fig. 72, ¹⁰) near the pubes between the fibres of the aponeurosis diverging to their attachment to two points of bone at a little distance from each other. It is somewhat triangular in form, with the base at the crest of the pubes, and the apex pointing upwards and outwards. The long measurement of the aperture is about an inch, and the transverse about half an inch.

External
abdominal
ring.

Form and
situation.

Size.

Fig. 73.*



Its margins are named pillars, and differ in form and strength :—The inner one (fig. 73, ¹) is thin and straight, and is attached below to the front of the symphysis pubis, where it crosses the corresponding piece of the opposite side—that of the right muscle being superficial. The outer

Inner side
or pillar.

* View of the lower part of the external oblique muscle and of the upper part of the fascia lata of the thigh (Quain's Anatomy). 1. Inner pillar of the abdominal ring. 2. Outer pillar of the ring. 3. Intercolumnar fibres. 4. Fascia lata inside the saphenous opening. 5. Spermatic cord covered by cremaster. 6. Saphenous vein. 7. Fascia lata of the thigh.

- Outer margin. margin is the strongest (fig. 73, ²), and is not straight like the inner, but is bent around the spermatic cord, so as to form a kind of groove for it: this margin is continuous with Poupart's ligament, and is attached below to the pubic spine or tuberosity. A thin membrane (intercolumnar or spermatic fascia) covers the sides of the opening, and is derived from some intercolumnar or intermarginal fibres on the surface of the aponeurosis.
- A fascia prolonged from the opening.
- The cord in male, The ring gives passage in the male to the spermatic cord, and in the female to the round ligament; and in each sex the transmitted part lies on the outer or lower margin or pillar as it passes through, and obtains a covering from the intercolumnar fibres. Through the same aperture the inguinal hernia protrudes from the wall of the abdomen.
- and hernial protrusion pass through it.
- Intercolumnar fibres. The *intercolumnar fibres* (fig. 73, ³) form a layer over the aponeurosis, and bind together its parallel fibres, so as to construct a resisting membrane. Inferiorly they are strongest; and there a bundle of the fibres is connected with the outer third of Poupart's ligament, and is continued back to the crista ilii. At the external abdominal ring they stretch from side to side (hence the origin of the name), and, becoming stronger and aggregated together, close the upper part of that opening. Moreover they are prolonged on the cord from the margin of the ring, and give rise to the membrane named *intercolumnar fascia*. On the left side, where the fascia is entire, this thin covering will be manifest on the surface of the cord, or on the round ligament in the female.
- Attachment inferiorly.
- They cross upper part of ring, and produce the thin intercolumnar fascia.
- To see insertion of Poupart's ligament. *Dissection.*—To see the attachments and connections of Poupart's ligament, it will be necessary to reflect, on both sides of the body, the lower part of the aponeurosis towards the thigh, as in fig. 74. For this purpose an incision is to be carried through the aponeurosis from the front of the iliac crest nearly to the linea alba. The aponeurosis is to be detached from the subjacent parts with the handle of the scalpel; and when it cannot be separated farther from the tendons beneath, near the middle line, it is to be cut in the direction of a vertical line to the symphysis pubis.
- Throw down piece of external oblique,
- and seek triangular ligament.
- After the triangular piece of the aponeurosis has been thrown towards the thigh, the spermatic cord is to be dislodged from the surface of Poupart's ligament, to see the insertion of this band into the pubes, and to lay bare the fibres which ascend therefrom to the linea alba with the name of triangular ligament.

Poupart's ligament (fig. 73, ²) is the lower border of the aponeurosis of the external oblique, which intervenes between the front of the crista ilii and the pubes. Externally it is round and cord-like, and is attached to the anterior

Poupart's ligament.

Fig. 74.*



superior iliac spine. Internally it widens as it approaches the pubes, and is inserted into the pubic spine, as well as into the pectineal line of the hip bone for about three quarters of an inch, forming a triangular-looking piece, with its base directed outwards, which is named *Gimbernat's ligament*.

Outer and inner attachments: forms Gimbernat's ligament.

Poupart's ligament is not straight between its outer and inner attachments, but is curved downwards to the thigh; and it retains this position as long as the fascia lata remains uncut. Its outer half is oblique, and is firmly united with

Its direction, and parts in contact with it.

* Dissection to throw down the tendon of the external oblique, and to show the triangular ligament and internal oblique muscle (Quain's Anatomy). 1. Tendon of external oblique reflected: at its inner attachment to the pubes, fibres are directed upwards obliquely to the linea alba; these form the triangular ligament. 2. Internal oblique. 3. Spermatheca.

the subjacent iliac fascia : along the line of union of the two, the other lateral muscles of the abdominal wall are attached. Its inner half is placed over the vessels passing from the abdomen to the thigh, and beneath the spermatic cord.

Triangular
ligament.

Triangular ligament (fig. 74).—From the insertion of Poupart's ligament into the pectineal line, some fibres are directed upwards and inwards beneath the inner pillar of the ring to the linea alba, where they blend with the other tendons. As the fibres ascend, they diverge and form a thin band, to which the name *triangular ligament* has been applied.

Dissection
to expose
internal
oblique.

Dissection.—The remnant of the upper part of the external oblique is now to be taken away, on both sides of the body, to see the parts underneath. The muscle may be detached by carrying the scalpel through the digitations on the ribs back to the free border, and then through the attachment to the crista ilii. It may be thrown forwards as far as practicable, after the nerves that cross the iliac crest are dissected out ; but in raising it care must be taken not to detach the rectus muscle from the ribs above, nor to cut through the tendon of the internal oblique above. By the removal of the fatty tissue the underlying internal oblique muscle, with some nerves on its surface below, will be prepared. At the lower border of the internal oblique the cremaster muscle is to be dissected out on the cord.

Clean the
cremaster.

Parts
covered by
external
oblique.

Parts covered by external oblique.—Beneath the external, is the internal oblique muscle, with the ribs and the intercostal muscles. At the lower part of the abdomen the external muscle conceals the cord, and the branches of nerves of the lumbar plexus in the abdominal wall. The aponeurosis of the external oblique is placed in front of the sheath of the rectus.

Internal
oblique
muscle.

The INTERNAL OBLIQUE MUSCLE (fig. 72, ¹⁴) is fleshy below and aponeurotic above, just the reverse of the preceding muscle ; and its fibres (except the lowest) ascend across the direction of those of the external oblique. The muscle *arises* along the outer half of Poupart's ligament ; along the anterior two thirds of the crest of the hip bone ; and from the tendon of the transversalis muscle (fascia lumborum) in the interval between that bone and the last rib. The fibres diverge on the abdomen to their destination :—The posterior fleshy fibres ascend to be *inserted* into the cartilages of the lower three ribs, and join the internal intercostal muscles of the lowest two spaces. The anterior or lower fibres arch

Origin from
pelvis.

Insertion
into the
ribs and
linea alba,

downwards and inwards (from Poupart's ligament) over the spermatic cord (fig. 74), and end in the aponeurosis near the pubes. The intervening fibres pass obliquely to the aponeurosis.

except lowest fibres.

The *aponeurosis* of the muscle covers the fore part of the abdomen from the pelvis to the chest, and blends with its fellow along the middle line. For the most part it incases the rectus; but midway between the umbilicus and the pubes it is undivided, and lies in front of that muscle. Superiorly it is attached to the thorax after the following manner: The stratum superficial to the rectus is fixed to the ninth rib, and blends with the aponeurosis of the external oblique; and the stratum beneath the muscle joins the cartilages of the seventh and eighth ribs and the ensiform cartilage. Inferiorly its fibres become more distinct and separate, as in the external oblique, and are inserted into the front of the pubes, and into the pectineal line for half an inch, behind the attachment of Poupart's ligament.

Aponeurosis of the muscle.

Divides to incase rectus.

Attachments to chest,

and the pelvis.

Connections of internal oblique.—The internal is covered by the external oblique muscle. It is attached on all sides, except between Poupart's ligament and the pubes where it arches over the cord, and has the cremaster muscle contiguous to it. The parts covered by the internal oblique cannot be seen till the muscle is reflected.

Parts in contact with oblique.

The CREMASTER MUSCLE (fig. 72, ^{1a}) is a fasciculus of fibres, which lies along the lower border of the internal oblique muscle, and is named from suspending the testicle. The muscle has attachments above, at the inner and outer sides, similar to those of the internal oblique. Externally it is fleshy, and is attached to Poupart's ligament below, and in part beneath the internal oblique, with which some of the fibres are connected; and it may also join the transversalis. Internally it is small and pointed, and is fixed by tendon to the front of the pubes and the sheath of the rectus. Between the two points of attachment the fibres descend on the front and sides of the cord, forming loops with the convexity downwards which reach to the tunica vaginalis testis. The muscular fibres are united by areolar tissue so as to give rise to a covering on the front of the cord, which is named *fascia cremasterica*. Occasionally the fibres may be behind as well as on the sides and front of the cord.

Cremaster muscle.

Attachments: external fleshy,

internal tendinous; forms loops over the cord,

giving rise to cremasteric fascia.

Dissection.—On the left side of the body the student is not to make any further dissection of the abdominal wall; but the parts that have been reflected in the groin should

In left groin replace the parts.

be carefully replaced, until the examination of those parts in connection with hernia is returned to.

On right
side reflect
cremaster

On the right side the dissection is to be carried deeper by the removal of the internal oblique and the cremaster.

The last muscle may be reflected from the cord by means of a longitudinal incision.

and internal
oblique.

To raise the internal oblique, it will be necessary to cut it through firstly near the ribs; secondly near the crest of the hip bone and Poupart's ligament; and lastly to divide it vertically behind, so as to connect the two first incisions. Its depth will be indicated by a fatty layer between it and the transversalis. In raising the muscle towards the edge of the rectus, the student must separate with great care the lower fibres from those of the transversalis, with which they are often conjoined; and must dissect out the trunks of the intercostal nerves and arteries, the last dorsal nerve, and the two branches of the lumbar plexus (ilio-hypogastric and ilio-inguinal) near the front of the crest of the hip bone. The offsets of the intercostals entering the muscle must be cut.

Parts
covered by
internal
oblique.

Parts covered by the oblique.—The internal oblique conceals the transversalis muscle, and the vessels and nerves between the two. Near Poupart's ligament it lies on the spermatic cord and the fascia transversalis. The rectus muscle is concealed by its aponeurosis, and is partly incased by it.

Transversa-
lis muscle.

The TRANSVERSALIS MUSCLE forms the third stratum in the wall of the abdomen, and differs from the two oblique in having a posterior as well as an anterior aponeurosis. Like the former muscle it is attached on all sides, except where the spermatic cord lies, and takes origin from the pelvis, the chest, and the lumbar vertebræ. At the pelvis it arises along the outer third of Poupart's ligament, and the anterior two thirds of the iliac crest. At the chest it takes origin from the lower six ribs, viz. by tendon from the lowest two, and by fleshy processes from the under surface of the cartilages of the four next above. And it is connected with the lumbar vertebræ, between the chest and the pelvis, by means of the posterior aponeurosis or the fascia lumborum. Most of the fibres are directed transversely to the aponeurosis in front; but the lower arch downwards above the spot at which the cord leaves the abdomen (fig. 75, ³), and end in the aponeurosis internal to that aperture.

Fibres end
in aponeu-
rosis.
Lowest arch
down to
pubes.

The aponeu-
rosis

Its aponeurosis is widest inferiorly, as in the most external

muscle. Above it is continued to the linea alba beneath the rectus, but midway between the umbilicus and the pubes it passes in front of that muscle to reach the middle line. Its attachment below to the pelvis is nearly the same as that of the aponeurosis of the internal oblique; for it is fixed to the front of the pubes, and to the pectineal line for about an inch, but beneath the insertion of the oblique muscle. At the insertion into the pubes some of the fibres are spent on the transversalis fascia, and are connected with a thickened band of that fascia beneath Poupart's ligament, which is called the deep crural arch.

passes beneath rectus to linea alba, except inferiorly.

Fibres to transversalis fascia.

Conjoined tendon.—The aponeuroses of the internal oblique and transversalis muscles are united more or less near their attachment to the bone, and thus give rise to the conjoined tendon; but the aponeurosis of the oblique muscle seldom extends more than half an inch along the pectineal line, whilst that of the transversalis reaches an inch along the bony ridge, and forms the greater part of the conjoined tendon.

At pelvis joins that of internal oblique in conjoined tendon.

The *posterior aponeurosis* of the transversalis, or the fascia lumborum, is described in the dissection of the back, p. 420.

Posterior aponeurosis.

Connections of the muscle.—Superficial to the transversalis are the two muscles before examined; and beneath it is the thin fascia transversalis, which separates it from the peritoneum. Its fleshy attachments to the ribs digitate with like processes of the diaphragm. The lower border is fleshy in the outer, but tendinous in the inner half, and is arched above the internal abdominal ring. Occasionally the muscle arises from Poupart's ligament as low down as the internal oblique, with which, and with the cremaster, it is then inseparably united.

Connections of transversalis muscle.

Dissection.—To remove the aponeurotic layer from the rectus muscle of the right side, make a longitudinal incision through the tendinous sheath, and turn it to each side. When the fascia is reflected, a small muscle, the pyramidalis, will be exposed near the pubes. The dissector should take care of the nerves entering the outer border of the rectus.

Expose rectus and pyramidalis.

On the left side of the body the rectus should not be laid bare below the umbilicus, for the sake of the hernia to be seen on this side.

Leave the left side.

The RECTUS MUSCLE (fig. 72, ¹⁶) extends along the front of the abdomen from the pelvis to the chest. The muscle is narrowest inferiorly, and is attached to the pubes by two tendinous processes;—one, internal to the other and the smallest, arises from the front of the symphysis, where it

Rectus muscle.

Attachments to pubes.

- joins the muscle of the opposite side ; and the external process is attached to the pubic crest. Becoming wider towards the thorax, the rectus is inserted by three large fleshy processes into the cartilages of the last three true ribs ; and the highest slip, which is also external, is attached to both the bone and cartilage of its rib. The muscle is contained in an aponeurotic sheath, except above and below ; and its fibres are interrupted at intervals by irregular tendinous lines,—the *inscriptiones tendineæ*.
- Insertion into ribs.** *Sheath of the rectus.*—The aponeurotic casing of the rectus is derived from the splitting of the aponeurosis of the internal oblique at the outer edge of the muscle. One piece passes before, and the other under the muscle ; and the two unite at the inner border so as to enclose it in a sheath. Inseparably blended with the stratum in front of the muscle is the aponeurosis of the external oblique ; and joined in a similar manner with that behind, is the aponeurosis of the transversalis.
- Has cross tendons.** The sheath is deficient behind, both above and below. Above, the muscle rests on the ribs, without the intervention of the sheath which is fixed to the margin of the thorax. Below, midway between the umbilicus and the pubes, the internal oblique ceases to incase the rectus, and passes altogether in front of it with the other aponeuroses ; at the spot where the sheath is wanting inferiorly, a white, and sometimes well-defined margin (the fold of Douglas) may be seen when the outer edge of the muscle is raised. Where the sheath is deficient the rectus is in contact with the fascia transversalis.
- Its sheath, how formed.** The *lineæ transversæ* are the tendinous intersections crossing the rectus. These give rise to the transverse markings on the surface of the abdomen, and are usually three in number. The position of the lines is at the following spots : one is opposite the umbilicus, another at the ensiform cartilage, and the third midway between the other two. If there is a greater number, the additional tendinous band will be placed below the umbilicus. These markings seldom extend the whole breadth or depth of the muscular fibres, more particularly above and below.
- Its extent.** The *lineæ transversæ* are the tendinous intersections crossing the rectus. These give rise to the transverse markings on the surface of the abdomen, and are usually three in number. The position of the lines is at the following spots : one is opposite the umbilicus, another at the ensiform cartilage, and the third midway between the other two. If there is a greater number, the additional tendinous band will be placed below the umbilicus. These markings seldom extend the whole breadth or depth of the muscular fibres, more particularly above and below.
- Deficient above and below.** The *lineæ transversæ* are the tendinous intersections crossing the rectus. These give rise to the transverse markings on the surface of the abdomen, and are usually three in number. The position of the lines is at the following spots : one is opposite the umbilicus, another at the ensiform cartilage, and the third midway between the other two. If there is a greater number, the additional tendinous band will be placed below the umbilicus. These markings seldom extend the whole breadth or depth of the muscular fibres, more particularly above and below.
- Lineæ transversæ are three or more.** The *lineæ transversæ* are the tendinous intersections crossing the rectus. These give rise to the transverse markings on the surface of the abdomen, and are usually three in number. The position of the lines is at the following spots : one is opposite the umbilicus, another at the ensiform cartilage, and the third midway between the other two. If there is a greater number, the additional tendinous band will be placed below the umbilicus. These markings seldom extend the whole breadth or depth of the muscular fibres, more particularly above and below.
- Situation.** The *lineæ transversæ* are the tendinous intersections crossing the rectus. These give rise to the transverse markings on the surface of the abdomen, and are usually three in number. The position of the lines is at the following spots : one is opposite the umbilicus, another at the ensiform cartilage, and the third midway between the other two. If there is a greater number, the additional tendinous band will be placed below the umbilicus. These markings seldom extend the whole breadth or depth of the muscular fibres, more particularly above and below.
- Linea semilunaris.** *Linea semilunaris.*—This line which was before alluded to with the aponeurosis of the external oblique muscle, corresponds with the outer edge of the rectus, and reaches from the eighth rib to the outer part of the pubic crest of the hip bone : it marks the line of division of the aponeurosis of the internal oblique muscle.
- Linea semilunaris is at edge of rectus.** *Linea semilunaris.*—This line which was before alluded to with the aponeurosis of the external oblique muscle, corresponds with the outer edge of the rectus, and reaches from the eighth rib to the outer part of the pubic crest of the hip bone : it marks the line of division of the aponeurosis of the internal oblique muscle.

The PYRAMIDALIS MUSCLE (fig. 72, ¹⁷) is triangular in form, and is placed in front of the rectus near the pelvis. The muscle *arises* by its base from the front of the pubes, and is *inserted* by tendon into the linea alba, about midway between the umbilicus and the pelvis. This small muscle is often absent.

Pyramidalis muscle.

Attachment.

NERVES OF THE ABDOMINAL WALL.—Between the internal oblique and transversalis muscles are the intercostal nerves; and near the pelvis are the two branches of the lumbar plexus. Some arteries accompany the intercostal nerves, but they will be referred to with the vessels of the abdominal wall (p. 498).

Nerves in wall of abdomen.

The *lower six intercostal nerves* (p. 403) enter the wall of the abdomen at the anterior part of the intercostal spaces. Placed between the two deepest lateral muscles, the nerves are directed forwards to the edge of the rectus, and through this muscle to the surface along the front of the abdomen. About midway between the spine and the linea alba, the nerves furnish cutaneous branches to the side of the abdomen (lateral cutaneous, p. 478); and whilst between the abdominal muscles they supply muscular branches, as well as offsets of communication with one another. A greater part of the lower than of the upper nerves is visible, because of the shortness of the last intercostal spaces.

Intercostal nerves

are between oblique and transversalis.

Offsets.

The *last dorsal nerve* is placed below the twelfth rib, and therefore not in an intercostal space, but otherwise it has connections and a distribution like the preceding. As it extends forwards to the rectus it communicates sometimes with the ilio-hypogastric nerve. Its lateral cutaneous branch perforates the two oblique muscles.

Last dorsal nerve.

Two branches of the lumbar plexus, viz., ilio-hypogastric and ilio-inguinal, are contained for a certain distance between the muscles of the wall of the abdomen, as they course forwards to the surface of the body.

Branches of lumbar plexus.

a. The *ilio-hypogastric nerve* perforates the back of the transversalis muscle near the iliac crest, and gives off the iliac or lateral cutaneous branch. The nerve is then directed forwards above the hip bone, and is connected with its companion (ilio-inguinal), near the front of the bone. Perforating the fleshy part of the internal oblique, and the aponeurosis of the external oblique near the linea alba, the nerve becomes cutaneous as before seen (p. 479).

Ilio-hypogastric lies near iliac crest.

The *iliac branch* pierces both oblique muscles close to the crista ilii, to reach the gluteal region.

Cutaneous branch.

b. The *ilio-inguinal nerve* perforates the transversalis near

Ilio-inguinal

issues
through
ring.

the front of the iliac crest, where it is connected with the preceding. The nerve afterwards pierces the internal oblique, to which it supplies branches, and coursing over that muscle, reaches the surface of the thigh through the external abdominal ring (p. 479).

May be very
small.

This nerve may be so small as to end by joining the ilio-hypogastric branch. In such cases the ilio-hypogastric furnishes an offset which takes the usual place of the ilio-inguinal nerve, and corresponds in distribution with it.

Dissection
of transvers-
alis fascia.

Dissection.—For the purpose of seeing the transversalis fascia, it will be necessary to raise, on the right side, the lower part of the transversalis muscle by two incisions;—one of these is to be carried through the fibres attached to Poupart's ligament; the other, across the muscle from the front of the hip bone to the margin of the rectus. With a little care the muscle may be separated easily from the thin fascia beneath.

Fascia
transversalis

is best
marked in
the groin.

The *fascia transversalis* is a thin fibrous layer between the transversalis muscle and the peritoneum, which has been so named by Sir A. Cooper. In the groin or inguinal region (fig. 75, ⁴), where it is unsupported by muscles, the fascia is considerably stronger than elsewhere, and is joined by fibres of the aponeurosis of the transversalis muscle; but farther from the pelvis it gradually decreases in strength, until at the thorax it becomes an unimportant thin membrane.

Near Pou-
part's liga-
ment is the
internal
abdominal
ring.

In the part of the fascia now laid bare is an opening—the internal abdominal ring, which gives passage to the spermatic cord, or the round ligament, according to the sex. On the inner side of that opening the fascia is thinner than on the outer side, and is fixed internally into the pubes and the pectineal line of the hip bone, behind the conjoined tendon with which it is united.

Is partly
joined to
Poupart's
ligament,
and partly
not.

When traced down to Poupart's ligament, this membrane will be found joined to the posterior margin of that band along the outer half; but only slightly connected with the ligament along the inner half, as it is directed down to the thigh in front of the bloodvessels, and forms the anterior part of a loose sheath (crural) around them.

Situation of
abdominal
ring.

Internal abdominal ring (fig. 75).—The opening called internal abdominal ring is situate midway between the symphysis pubis and the anterior superior iliac spine, and half an inch above Poupart's ligament. From its margin a thin tubular prolongation of the fascia is continued around the cord.



SPERMATIC CORD.

495

Dissection.—The prolongation of the fascia transversalis on the cord may be traced by cutting the fascia horizontally above the opening of the ring, and then longitudinally over the cord. With the handle of the scalpel the thin membrane may be reflected to each side from the subperitoneal fat.

Dissection to trace process on cord.

After the subperitoneal fat has been seen, let it be reflected to trace the remains of a tube of peritoneum along the cord, in the form of a fibrous thread.

and remains of peritoneum.

The *subperitoneal fat* forms a layer between the fascia transversalis and the peritoneum. Its depth varies much in different bodies, but the stratum is thicker at the lower part of the abdomen than higher up. A prolongation is sent from it along the cord. This structure will be more specially examined in the dissection of the wall of the abdomen from the inside.

Subperitoneal fat in the groin.

The *peritoneum*, or the serous sac of the abdominal cavity, projects forwards slightly opposite the abdominal ring. Connected with it at that spot is a fibrous process, the remains of a prolongation to the testis in the fetus, which extends a certain distance along the front of the cord. There is great variety in the condition of the process. In one body it can be followed only a very short distance, whilst in another it may be traced as a fine thread to the tunica vaginalis of the testis. In other instances the process may be sacculated at intervals, or, in rarer cases, it may form only one large bag in front in the cord. The last two conditions can be explained by an arrest in the obliteration usually taking place in the piece of peritoneum prolonged to the testis; for should the tube be closed only opposite the abdominal ring, one large pouch or sac would be left in front of the cord and testicle; and should it be obliterated here and there, the sacculated state would result. Lastly, as a rare condition, the tube of peritoneum may be found unobliterated, so that a coil of intestine could descend in it from the abdomen.

Peritoneum of the groin is prolonged on the cord;

pieces may be imperious,

or sacculated,

or open.

In the female the tube of peritoneum remains sometimes pervious for a short distance in front of the round ligament; the unobliterated passage is named the *canal of Nuck*.

In female, partly open.

The *SPERMATIC CORD* extends from the internal abdominal ring to the testis, and consists of the vessels and the efferent duct of the gland, united together by coverings from the structures by or through which it passes. In the wall of the abdomen the cord lies obliquely, because its aperture of entrance amongst, is not opposite its aperture of exit from the muscles; but escaped from the abdomen, it descends

Spermatic cord

is oblique in the abdominal wall

and vertical beyond.
Connections with parts around.

almost vertically to its destination. As it lies in the passage named the inguinal canal, it is placed at first (beginning externally) beneath the internal oblique, and rests against the fascia transversalis (fig. 75); but beyond the lower border of the oblique muscle, or nearer the pubes, it rests on the upper surface of Poupart's ligament, and has the aponeurosis of the external oblique between it and the surface of the body, and the conjoined tendon behind it (fig. 74).

Coverings. Its several coverings are derived from the different strata in the wall of the abdomen, except from the transversalis muscle. Thus, in proceeding from within outwards, the student will find the following layers around the constituents of the cord:—first the subperitoneal fat; then the tube of the fascia transversalis; next the cremaster muscle continuous with the internal oblique; afterwards the intercolumnar fascia from the external oblique muscle; and lastly the superficial fascia and the skin.

In female round ligament is in place of cord.

The *round ligament*, or the suspensory cord of the uterus, occupies the inguinal canal in the female, and ends in the integuments of the groin. Its coverings are similar to those of the spermatic cord, except it wants usually the cremaster.

Dissection. *Dissection.*—The constituents of the cord will be displayed by turning aside the different surrounding layers, and removing the areolar tissue. The dissector should trace branches of the genito-crural nerve and epigastric artery into the cremasteric covering.

Constituents of the cord.

Vessels and nerves of the cord.—In the cord are collected together the spermatic artery and veins which convey the blood to, and take it away from the testis; nerves and lymphatics of the testicle; and the vas deferens or the efferent duct.

Spermatic artery;

The *spermatic artery* is a branch of the aorta. It enters the cord through the internal abdominal ring, and descends to the testis, in which it ends: it distributes branches to the vas deferens and the epididymis.

offset of ovarian.

In the female, a *branch* from the *ovarian artery* enters the round ligament.

Spermatic veins,
and plexus.

The *spermatic veins* leave the posterior part of the testicle, and receive branches from the epididymis: ascending in the cord, in front of the vas deferens, they divide and anastomose, and form the *spermatic plexus*.

Artery and nerve of the coverings of the cord:

Cremasteric artery and nerve.—The cremasteric covering of the cord has a separate artery and nerve. The *artery* is derived from the epigastric (p. 492), and is distributed to

the coverings of the cord. The *genital branch* of the *genito-crural* nerve enters the cord by the internal abdominal ring, and ends in the cremaster muscle.

Other vessels and nerves are supplied to the coverings of and others. the cord from the superficial pudic artery and the ilio-inguinal nerve.

The *vas deferens* reaches from the testicle to the urethra, Vas deferens. and is placed behind the other constituents of the cord ; it will be easily recognised by its resemblance in feel to a piece Situation of whipcord, when it is taken between the finger and the thumb. As it enters the abdomen through the opening in and course. the fascia transversalis (internal ring), it lies on the inner side of the vessels of the testicle ; and as it begins its descent to the pelvis, it winds behind the epigastric artery.

Dissection.—A fibrous band below Poupart's ligament, Dissection of deep arch which has been named the deep crural arch, will be found by cutting through the cord near the pubes, and raising this towards the inner abdominal ring : the thin band passes inwards to the pubes, and is to be defined with care.

The remaining vessels of the abdominal wall, viz., the epigastric and circumflex iliac, and the ending of the internal mammary artery, are to be next dissected. The epigastric and mammary arteries will be seen on turning up the outer edge of the rectus, one above and the other below, ramifying in the muscle ; and the epigastric with its earliest branches may be traced further, by removing the fascia transversalis from it near Poupart's ligament. The circumflex iliac artery lies behind the outer half of Poupart's ligament, and should be pursued along the iliac crest. and of the vessels in the wall of abdomen.

Deep crural arch.—Below the level of Poupart's ligament Deep crural arch. is a thin band of transverse fibres, which lies over the femoral vessels, and has received the name deep crural arch from its position and resemblance to Poupart's ligament,—the superficial crural arch. This fasciculus of fibres beginning about the centre of the ligament, is prolonged inwards to the pubes, where it is widened, and is inserted into the pectineal line at the abdominal aspect of the conjoined tendon of the broad muscles of the abdomen.* This Attachments.

* Sometimes this structure is a firm distinct band, and is joined, as it would seem, by some of the lower fibres of the aponeurosis of the external oblique. At other times, and this is the most common arrangement, it is only a thickening of the fascia transversalis with fibres added from the tendon of the transversalis muscle. In six bodies, both male and female, which I examined carefully, I found the deep arch to be formed only by a thickening of the fascia transversalis.

- structure is closely connected with the front of the crural sheath, and is arched down on the inner side of that tube to be fixed to the bone.
- Vessels in abdominal wall.** **VESSELS IN THE WALL OF THE ABDOMEN.**—On the side of the abdomen are the intercostal and lumbar arteries with the intercostal nerves. In the sheath of the rectus are the epigastric and internal mammary vessels. And around the crest of the hip bone is the circumflex iliac branch.
- Intercostal arteries.** The *intercostal arteries* issue from the spaces between the ribs, and enter the abdominal wall between the transversalis and internal oblique muscles: they extend forwards with the nerves, supplying the contiguous muscles, and anastomose in front with the internal mammary and epigastric, and behind with the lumbar arteries.
- Lumbar.** *Lumbar artery.*—The vessel accompanying the last dorsal nerve is furnished by the first lumbar artery.
- Internal mammary.** The *internal mammary artery.*—The abdominal branch of this vessel (p. 274) enters the wall of the abdomen beneath the cartilage of the seventh rib. Descending for a short distance in the sheath of the rectus, the vessel enters the substance of that muscle, and anastomoses in it with the epigastric artery.
- Musculo-phrenic.** The *musculo-phrenic* part of the same artery passes outwards along the margin of the thorax to the last intercostal space. It appears on the under surface of the diaphragm at the ninth rib, and gives offsets to that muscle and the lower intercostal spaces.
- Epigastric anastomoses with internal mammary.** The *epigastric artery* arises from the external iliac about a quarter of an inch above Poupart's ligament; it ascends in the sheath of the rectus above the umbilicus, and divides into branches which enter the muscle, and anastomose with the internal mammary. As it courses to the rectus, the artery passes beneath the cord and on the inner side of the internal abdominal ring; and it is directed obliquely inwards across the lower part of the abdomen, where it forms the outer boundary of a triangular space close to the edge of the rectus. In this course the vessel lies at first beneath the fascia transversalis; but it soon perforates the fascia, and enters the sheath of the rectus over the defined border at the posterior aspect.
- Connections in wall of abdomen.** The *branches* of the artery are numerous but inconsiderable in size:—
- Branches.** *a.* The *pubic branch* is a small transverse artery, which runs behind Poupart's ligament to the posterior aspect of the pubes, and anastomoses with a similar branch from the
- Pubic joins obturator by an offset.**

opposite side. Behind the pubes it communicates with a small offset from the obturator artery: the size of this anastomosis varies much, but its situation is internal to the crural ring.

b. A *cremasteric branch* is furnished to the coverings of the cord as before mentioned. Cremas-
teric.

c. *Muscular branches* are given from the outer side of the artery to supply the abdominal wall, and to anastomose with the intercostal arteries. Other branches enter the rectus. Muscular.

d. Some *cutaneous offsets* pierce the rectus, and ramify in the integument with the anterior cutaneous nerves. Cutaneous.

Two *epigastric veins* are found with the artery; they join finally into one, and open into the external iliac vein. Epigastric
veins.

The *circumflex iliac artery* arises from the outer side of the external iliac, opposite the epigastric, and then courses outwards around the iliac crest, as the name expresses. Having pierced the tube of membrane around the upper part of the femoral vessels, the artery lies at first below Poupart's ligament, and passes next beneath the transversalis muscle to the middle of the crest of the hip bone. Here the vessel pierces the transversalis, and is continued backwards between this and the internal oblique, to anastomose with the ilio-lumbar branch of the internal iliac artery. Its branches are muscular and anastomotic. Circumflex
iliac

is in wall of
abdomen,

and anasto-
moses with
ilio-lumbar.

Branches.—Near the front of the iliac crest a small branch ascends between the internal oblique and transversalis muscles (fig. 75), supplying them, and anastomoses with the epigastric and lumbar arteries. As the vessel extends backwards it gives lateral offsets, which supply the neighbouring muscles, and communicate on the one side with the ilio-lumbar, and on the other with the gluteal artery. Muscular
offsets.

The *circumflex iliac vein* accompanying the artery is formed by the junction of two collateral branches, like the epigastric, and crosses the external iliac artery, nearly an inch above Poupart's ligament, to open into the external iliac vein. Circumflex
vein.

SECTION II.

HERNIA OF THE ABDOMEN.

The lower part of the abdominal wall, which has been Inguinal
hernia.

reserved on the left side of the body, should be now dissected for inguinal hernia.

The dissection on the left groin.

Dissection.—The skin, the superficial fascia, and the aponeurosis of the external oblique having been already reflected in the previous examination of the wall of the abdomen, the necessary dissection of the inguinal region will be completed by reflecting the internal oblique muscle as in fig. 75, ².

Reflect oblique.

To raise upwards the oblique muscle, its lower fleshy origin from Poupart's ligament must be detached. For this purpose let one incision be made across the fleshy part of the internal oblique, from the iliac crest towards the linea alba; and after the depth of the muscle has been ascertained by the layer of areolar and fatty tissue beneath it, let the lowest fibres be carefully cut through at their origin from Poupart's ligament. By detaching the muscle cautiously, the student will be able to raise it from the subjacent transversalis, so that it may be turned upwards on the abdomen (fig. 75). The separation of the two muscles just mentioned is sometimes difficult in consequence of their fibres being blended together, but a branch of the circumflex iliac artery marks their intermuscular space.

Cut the cremaster.

The cremaster muscle is then to be divided along the cord, and to be reflected to the sides.

Clean subjacent parts.

Let the dissector clean the surface of the transversalis muscle, without displacing its lower arched border; and trace with care the conjoined tendon of the internal oblique and transversalis, to show its exact extent outwards. The fascia transversalis and the spermatic cord should be likewise nicely cleaned.

Show the epigastric vessels.

Crossing the interval apparent below the border of the transversalis muscle, is the epigastric artery, which lies close to the inner side of the internal abdominal opening, but beneath the fascia transversalis. A small piece of the fascia should be cut away to show the vessel on the side of the abdominal ring.

Situation of inguinal hernia.

INGUINAL HERNIA.—A protrusion of intestine through the lower part of the abdominal wall near Poupart's ligament (the part answering to the inguinal region), is named an inguinal hernia. The escape of the intestine in this region is predisposed to by the deficiency in the muscular strata, by the passage of the spermatic cord through the abdominal parietes, and by the existence of fossæ on the inner surface of the wall.

Predisposition naturally.

Course it follows.

The gut in leaving the abdomen either passes through

the internal abdominal ring with the cord, or is projected through the part of the abdominal wall between the epigastric artery and the edge of the rectus muscle.

The hernia of this region is distinguished by the names external and internal, from its position to the epigastric artery; and it is called also oblique and direct, from the direction it takes through the abdominal wall. Thus the hernia protruding through the internal abdominal ring with the cord is called external from being outside the artery, and oblique from its slanting course; whilst the hernia between the edge of the rectus and the epigastric artery is named, in like manner, internal from being inside the artery, and direct from its straight course.

Two kinds,
external or
oblique;

EXTERNAL or OBLIQUE INGUINAL HERNIA leaves the cavity of the abdomen with the spermatic cord, and traversing the inguinal canal, makes its exit from the abdominal wall by the external abdominal ring.

External or
oblique.

Anatomy of the external hernia.—To acquire a knowledge of the anatomy of this hernia it will be necessary to study the space in which it lies (inguinal canal), the apertures by which it enters and leaves the wall of the abdomen (abdominal rings), and the coverings it receives in its progress to the surface of the body.

Anatomy of
parts con-
cerned.

The *inguinal canal* (fig. 75) is the interval between the flat muscles of the abdominal wall, which contains the spermatic cord in the male, and the round ligament in the female. Its direction is oblique downwards and inwards, being nearly parallel to Poupart's ligament; and its length is about one inch and a half. Superiorly it communicates with the cavity of the abdomen by the internal abdominal ring; and inferiorly it ends at the external abdominal ring.

Inguinal
canal.

Direction.

Length.

Openings.

Towards the surface of the body the canal is bounded by the two oblique muscles though unequally:—Thus in its outer third (half an inch) it is formed by both muscles; but at the inner or lower two thirds (one inch) it is bounded only by the aponeurosis of the external oblique. Superficial to the muscular parts, are the skin and fat.

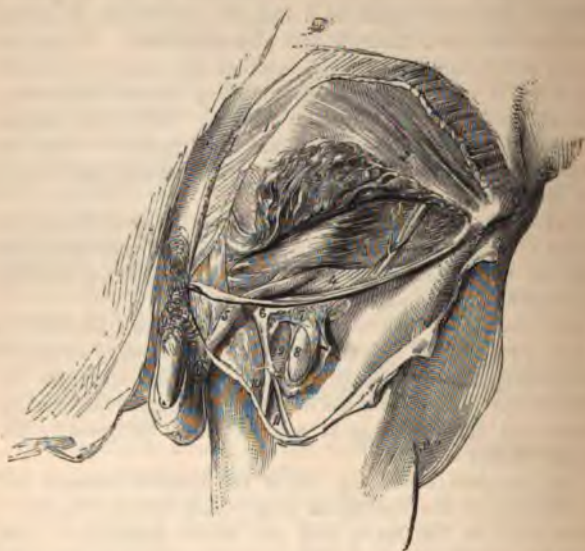
Boundaries
next sur-
face.

Towards the cavity of the abdomen the wall of the canal is constructed chiefly by the fascia transversalis, and the conjoined tendon of the internal oblique and transversalis in this wise:—The transversalis fascia reaches all the distance, like the external oblique; and the conjoined tendon is placed in front of it for about an inch below. Deeper than the transversalis fascia are the subperitoneal fat and the peri-

Next the
abdominal
cavity.

toneum, which correspond with the skin and superficial fascia on the outer surface. Occasionally the triangular ligament projects far enough outwards behind the external

Fig. 75.*



abdominal ring to take part in the formation of the posterior wall of the canal.

Flooring
and roof of
the canal.

Along the lower part, or the floor, the canal is limited by the union of the fascia transversalis with Poupart's ligament, and by the fibres of the ligament inserted into the pectineal line; whilst along the upper part its extent is determined by the apposition of the muscles.

Canal in the
female.

In the female, the canal has the same length and boundaries, though it is usually somewhat smaller. In that sex it lodges the round ligament.

* View of the inguinal canal, the external and internal oblique muscles being reflected (Quain's Anatomy). 1. External oblique. 2 and 2'. Internal oblique. 3. Transversalis muscle. 4. Transversalis fascia. 5. Spermatic cord covered by a tube from the transversalis fascia. 6. Upper end of the falciform border of the saphenous opening. 7. Crural sheath. 8. Femoral artery. 9. Femoral vein; and the small space inside it above is the crural canal. 10. Saphenous vein, with a branch 11.

The *internal abdominal ring* (fig. 75, ⁴) is an aperture in the fascia transversalis, which is situate mid-way between the symphysis pubis and the iliac crest, and half an inch above Poupart's ligament. Arching above and on the inner side of the aperture, is the lower border of the transversalis muscle; this is fleshy at the outer, but tendinous at the inner half. On the inner side of the opening lie the epigastric vessels. It is oval in form, the extremities of the oval being directed upwards and downwards, and the fascia at its outer and lower parts is stronger than at the opposite side.

Internal abdominal ring.
Situation.
Upper and inner boundary.
Form and margin.

This opening in the fascia transversalis is the inlet to the inguinal canal, and through it the cord, or the round ligament, passes into the wall of the abdomen. The external hernia leaves likewise the abdomen at the same spot. All the protruding parts receive as a covering the prolongation from the margin of the opening.

Parts transmitted through it.

The *external abdominal ring* (fig. 73) is the outlet of the inguinal canal, and through it the cord, or the inguinal hernia, reaches the surface of the body. This aperture is placed in the aponeurosis of the external oblique muscle, near the crest of the pubes; and from the margin a prolongation is sent on the parts passing through it (see p. 485).

External abdominal ring.
Situation.

Course and coverings of the hernia.—A piece of intestine leaving the abdomen with the cord, and passing through the inguinal canal to the surface of the body, will obtain the same coverings as the cord, viz., one from every structure in the lateral part of the wall of the abdomen, except from the transversalis muscle.

The intestine, following the course of the cord,

It receives its investments in this order:—As the intestine is first thrust outwards, it carries before it the peritoneum and the subperitoneal fat, and enters the tube of the fascia transversalis (infundibuliform fascia) around the cord. Still increasing in size the piece of gut is forced downwards to the lower border of the internal oblique muscle, where it will have the cremasteric fascia or covering applied to it. The intestine is afterwards directed along the front of the cord to the external abdominal ring, and in passing through that opening receives the investment of the intercolumnar or spermatic fascia. Lastly, as the hernia descends towards the scrotum, it has the additional coverings of the superficial fascia and the skin. So that in a hernia which has passed the external abdominal ring, the coverings from without inwards are the following:—the skin and the superficial fascia, the spermatic and cremasteric fasciæ, the fascia trans-

has coverings of the peritoneum and fat, fascia transversalis, cremaster, spermatic fascia, superficial fascia, and skin,

versalis, the subperitoneal fat, and the peritoneum or sac. These different laminae become much thickened in a hernia that has existed for some time.

Should a piece of intestine remain in the inguinal canal, the layers investing it will depend upon the spot to which it has extended.

Stricture *Seat of stricture.*—The protruded intestine may be constricted firstly at the internal abdominal ring by fibrous bands outside, or by a thickening inside the neck of the sac; secondly in the inguinal canal by the fleshy internal oblique muscle; and thirdly at the external abdominal ring. The stricture is placed usually at one of the abdominal rings, though most commonly at the inner. Supposing the stricture to be inside the neck of the sac, so as to render necessary the opening of the sac and the division of the strictured part from within, the incision should be made directly upwards.

The taxis. Whilst efforts are being made to force back a piece of protruded intestine during life, the direction of the canal and the situation of the internal abdominal ring should be borne in mind.

Terms applied to the inguinal hernia from its position. *Other designations.*—This kind of hernia has other names applied to it sometimes by surgeons, according as it has passed certain points in the wall of the abdomen. If the protrusion remains in the inguinal canal, the term *bubonocoele* is applied to the swelling; but if it has extended into the scrotum, the appellation *scrotal rupture*, or *oscheocoele*, is given to it.

Two varieties; *Varieties of the external hernia.*—There are two varieties of the oblique inguinal hernia, which are distinguished by the condition of the peritoneal covering.

congenital hernia, *a. Congenital hernia.*—If the piece of the peritoneum, which accompanies the testicle from the abdomen in the fetus, remains unobliterated, and the intestine descends in it without protruding any fresh piece of the serous membrane, the hernia is called congenital.

infantile hernia. *b. Infantile hernia.*—Should the prolongation of the peritoneum be only partly obliterated, say in the inguinal canal, so that the descending intestine, invested by a separate peritoneal covering, projects into or behind the unobliterated sac, like a viscus into a serous membrane, the hernia is named infantile.

Internal hernia comes behind external ring. The INTERNAL or DIRECT INGUINAL HERNIA escapes on the inner side of the epigastric artery, and has a straight course through the abdominal parietes and the external abdominal

ring. Its situation and coverings, and the seat of stricture, will be better comprehended after the examination of the part of the abdominal wall through which it passes.

Anatomy of the internal hernia.—At the lower part of the abdominal wall is a triangular space between the epigastric artery on one side, the outer edge of the rectus muscle on the other, and the inner half of Poupart's ligament below. Over the inner two thirds of the area of the space the conjoined tendon of the internal oblique and transversalis is stretched, as it descends to its insertion into the pectineal line; but at the outer third there exists only fascia transversalis.

It passes through a triangular space,

which is strengthened in part by conjoined tendon.

Any intestine protruding in this spot must rupture or elongate the different structures, because there is not any aperture or tube by which it can descend, as in the external hernia. Further, the coverings of the hernia, and its extent and direction in the lower part of the inguinal canal, must vary according as the gut is forced through the portion of the space covered by the conjoined tendon, or through the part external to that tendon.

Hernia in this space of two kinds.

Course and coverings of the hernia.—The common kind of the internal hernia (inferior) does not accompany the cord along the inguinal passage, but passes through the inner part of the triangular space which is covered by the conjoined tendon, and straight through the external abdominal ring.

Coverings of the more common kind are

The intestine in protruding carries before it the peritoneum, the subperitoneal fatty membrane, and the fascia transversalis; next it either elongates the conjoined tendon, or, as is the case in a sudden rupture, separates the fibres, and escapes between them. Then the intestine advances into the lower part of the inguinal canal, where it is opposite the external abdominal ring; and it passes outwards through the ring, lying on the inner side of the cord, and receiving at the same time the covering of the fascia spermatica. Lastly it is invested by the superficial fascia and the skin.

peritoneum and sub-jacent fat, fascia transversalis, conjoined tendon,

spermatic fascia, superficial fascia, and skin.

In number the coverings of the internal hernia are the same as those of the external; and in kind they are the same, with this exception, viz., that the conjoined tendon is substituted for the cremasteric fascia.

Seat of stricture.—The stricture in this form of hernia occurs most frequently around or in the neck of the sac; next in frequency at the margin of the fissured tendon; and lastly at the external abdominal ring. Where it is necessary

Stricture. Situation.

- to open the hernial sac to relieve the stricture, after having divided constricting bands external to the neck, the cut is to be made directly upwards as in the external hernia.
- Its division.**
- The taxis.** The position of the openings in the abdominal wall should be kept in mind during attempts to reduce an internal hernia ; and the straightness of the course of the intestine in this kind, in comparison with an external hernia, should be remembered.
- Rarer kind of internal hernia** *Variety of internal hernia.*—Another kind of internal hernia (superior) projects through that part of the area of the triangular space, which is external to the conjoined tendon. Its existence is determined by the unusual position of the obliterated hypogastric artery behind the wall of the abdomen (p. 507).
- is farther out than the preceding in the triangular space, and is oblique in direction.** If this hernia existed, it is evident that it would pierce the abdominal wall close to the epigastric artery, and would descend along nearly the whole of the inguinal canal to reach the external abdominal ring ; consequently the term direct would not apply strictly to the form of internal hernia now under consideration.
- Coverings are same as in external hernia.** *Coverings.*—As this internal hernia traverses nearly the whole of the inguinal canal, it has exactly the same coverings as the external hernia, viz., the skin and the superficial fascia, the spermatic and cremasteric fasciæ, the fascia transversalis, and the subperitoneal fat and the peritoneum.
- Stricture at same spots.** *Seat of stricture.*—The constriction of the intestine will take place from similar causes, and will be found at the same spots as in the external hernia ; and from the inability always to decide in the living body whether a hernia is internal or external, the rule observed in dividing the internal stricture of the neck of the sac is to cut directly upwards, as in the other kinds of inguinal hernia.
- Division of it.**
- Umbilical hernia.** **UMBILICAL HERNIA**, or exomphalos, is a protrusion of the intestine either through or by the side of the umbilicus.
- Course.** It is very variable in size, and its course is straight through the abdominal wall.
- Coverings** *Coverings.*—The coverings of the intestine in a small hernia are thin, and few in number ; they are the skin and the superficial fascia ; a prolongation from the tendinous margin of the abdominal opening ; together with the remaining deep coverings of the fascia transversalis, the subperitoneal fat and the peritoneum. If the hernia is suddenly produced, it may want the investment that otherwise is derived from the tendon of the external oblique muscle. Over the end of the tumour the fat in the superficial fascia disappears,
- become united over the tumour.**

and this covering becomes blended with the other contiguous structures.

Seat of stricture.—The stricture on the intestine is generally found at the margin of the tendinous opening in the abdominal wall; and it may be either in or outside the neck of the sac, as in the other kinds of hernia. It should be remembered that the narrowed neck is at the upper part, and not in the centre of the swelling. The constriction may be removed by cutting the parts around the neck. Or if the sac is opened the knife may be carried upwards, but there is not any vessel to be injured in the operation.

OTHER FORMS OF HERNIA.—At each of the other apertures in the parietes of the abdomen, a piece of intestine may be protruded, so as to form a hernial tumour. For instance there may be *femoral hernia* below Poupart's ligament, with the femoral vessels; *obturator hernia* through the thyroïd foramen, with the artery of the same name; and *ischiatric hernia* through the ischiatic notch.

The femoral hernia, as the most important, will be noticed presently; but the student must refer to some special treatise for his information respecting the other abdominal herniæ.

Dissection.—The abdomen may be now opened to see the cords and the depressions on the posterior surface of the abdominal wall. For that purpose a transverse cut is to be made through the umbilicus across the front of the abdomen. On holding up the lower part of the abdominal wall the cords will be seen ascending to the umbilicus from the pelvis.

Cords of the abdominal wall.—In the middle line of the abdominal wall, at its posterior aspect, is the prominence of the remains of the urachus, which reaches from the summit of the bladder to the umbilicus. On each side is another cord, formed by the obliterated hypogastric artery; this is directed from the side of the pelvis to the umbilicus, and lies usually behind or close to the epigastric artery, near Poupart's ligament.

Fossæ.—When the disposition of the cords is such as above mentioned, two fossæ are seen near Poupart's ligament, one on each side of the obliterated hypogastric artery, which correspond with the situation of the internal and external abdominal rings, and with the places where the external and internal (common kind) herniæ occur.

But occasionally the cord of the obliterated hypogastric

Stricture,
where
found.

Other
abdominal
herniæ are

femoral,
obturator,
ischiatric.

Dissection.

Cords inside
abdomen;

one in
middle line,
another on
each side,

forming two
fossæ.

Sometimes

last cord moved inwards is moved inwards from the epigastric artery, to the line of junction of the outer with the inner two thirds of the triangular space through which the direct hernia comes. In this condition of the cord there would be a hollow or causing three fossæ. fossa on each side of it at the lower part of the abdomen, corresponding with the spots at which the two kinds of internal hernia escape. When the hypogastric cord has the unusual position mentioned, there may be three fossæ at each side, on the lower part of the abdominal wall; viz. one between it and the urachus, another between it and the epigastric vessels, and a third outside the epigastric artery. And there may be one, two, or three kinds of inguinal hernia on each side, according to the number of the fossæ.

Number of the hernial protrusions.

Situation of the femoral hernia.

FEMORAL HERNIA.—In this hernia the intestine leaves the abdomen below Poupart's ligament, and descends in the loose membranous sheath around the femoral vessels. The course that the intestine takes, and the coverings that it receives, will be readily understood after the anatomy of the parts among which it passes has been learnt. Only so much of the structures will be described here as can be now seen, the rest are noticed fully in the dissection of the thigh.

Dissection.—The examination of the parts concerned in the femoral hernia is to be made on the left side of the body.

Dissection of the parts concerned.

The lower portion of the abdominal wall is to be divided from the umbilicus to the pubes. The peritoneum is to be detached from the inner surface of the wall and the iliac fossa; and the layer of the subperitoneal fat is to be separated in the same way, but before doing this it will be necessary to cut through the cord at the abdominal ring. As the last layer is raised, one or more lymphatic glands will be seen by the side of the iliac vessels. Any loose tissue that remains is to be taken away to show the upper opening of the membranous sheath which contains the femoral vessels. In this dissection the genito-crural nerve is seen on the iliac artery.

Afterwards the iliac fascia and the fascia transversalis are to be traced to Poupart's ligament, to see the part that each takes in the production of the crural sheath.

Anatomy of the structures.

Anatomy of femoral hernia.—The structures concerned in the femoral hernia are severally to be examined, viz. the subperitoneal fat; the membranes (transversalis and iliac fascia) lining the interior of the abdominal cavity near

Poupart's ligament, with the sheath to which they give origin ; and lastly, the crural ring, or the space through which the hernia leaves the abdomen.

The *subperitoneal fat* extends as a continuous layer beneath the peritoneum, but it is thickest and most fibrous at the lower part of the abdomen where the vessels pass under Poupart's ligament. At that spot it extends over the upper opening of the sheath of the vessels, instead of descending in it around the vessels ; and internal to the vein, it covers a space named crural ring, as well as a lymphatic gland which occupies that space. The piece of the layer that stretches over the crural ring is named by M. Cloquet *septum crurale* ; and it is described by him as being concave towards the abdomen, and convex towards the thigh. An inguinal gland is generally attached to its under surface.

Fig. 76.*



The *fascia transversalis* (fig. 76, ⁷) has been before described (p. 494). When traced down to Poupart's liga-

Fascia transversalis.

* Inner view of the abdominal wall and of the fascia constructing the crural sheath (Quain's Anatomy). 1, 2, and 4, refer to parts of the hip bone. 5. Internal obturator muscle. 6. Rectus abdominis. 7. Transversalis fascia covering the transversalis muscle. 8. Iliac

ment, it may be seen to join the iliac fascia external to the situation of the large iliac artery; but internal to that spot it is continued downwards to the thigh in front of the femoral vessels, and forms the anterior part of the crural sheath.

Iliac fascia. The *iliac fascia* (fig. 76, *) covers the iliacus muscle, and lies beneath the iliac vessels. At Poupart's ligament its disposition is similar to that of the transversalis fascia; for external to the iliac vessels it joins the fascia transversalis along the line of the ligament; but, internal to the spot mentioned, it is prolonged behind the vessels into the posterior part of the crural sheath.

Sheath on femoral vessels formed by offsets of preceding. The *crural sheath* is the loose membrane that encloses the femoral vessels as they enter the thigh. It is obtained from the membranes that line the abdomen. Its anterior half is continuous with the fascia transversalis, and its posterior half is derived from the fascia iliaca. The whole of the upper part of the sheath is not filled by the vessels, for a space (crural ring) exists on the inner side of the vein (fig. 76), which contains a gland, and through which the intestine descends in femoral hernia.

A space on inner side of the vessels is the crural ring. The *crural ring* is described partly in the dissection of the thigh, but its boundaries are better seen now in the examination of the abdomen. It is the interval in the sheath, at the inner side of the femoral vein (fig. 76); it is about half an inch wide, and is filled by a lymphatic gland. Bounding it internally, are the crural sheath, Gimbernat's ligament, and the conjoined tendon; and limiting it externally is the femoral vein without the intervention of the sheath. In front of the crural sheath and ring is Poupart's ligament with the deep arch, and behind is the pubes. Along the front of the space, but outside the tube of fascia, lies the spermatic cord in the male, and the round ligament in the female.

Size and boundaries. *Position of vessels around the ring* (fig. 76).—Commonly the crural ring is almost surrounded by vessels. Thus, on the outer side is the femoral vein; and above it, on the outer side, are the epigastric vessels. In front is a small branch (pubic) from the epigastric artery to the back of the pubes; and the vessels of the spermatic cord

Usual vessels around ring.

fascia covering the iliacus muscle. 9. Psoas magnus muscle cut. 10. Iliac artery. 11. Iliac vein: the dark interval on its inner side indicates the crural ring. 12. Epigastric artery and its two veins. 13. Parts of the spermatic cord lying in the internal abdominal ring. 14. Obturator vessels with the unusual arrangement.

may be said to be placed along the anterior aspect of the ring. The ring is bounded therefore by vessels except internally and behind.

But in some bodies the obturator artery takes origin from the epigastric, and comes to lie along a part of the ring as it passes to the pelvis. In that course it may have two positions with respect to the ring :—either it lies close to the iliac vein, and therefore on the outer side of the ring ; or it arches over the ring, descending on the inner side at the base of Gimbernat's ligament. If the artery takes the first-mentioned course, which is the most frequent arrangement, the inner side of the ring will be free from vessels ; but in the other condition the ring will have an additional vessel on the inner side, and will be encircled except at the posterior part.

State of unusual vessels.

Course and coverings of femoral hernia.—The intestine leaves the abdomen by the opening of the crural ring ; and it descends in the large crural sheath on the vessels, internal to the vein, as far as the saphenous opening, where it projects to the surface of the thigh. In its progress the intestine will push before it the peritoneum, and the subperitoneal fat (septum crurale) ; and it will displace, or cause to be absorbed the gland that fills the crural ring. Having reached the level of the saphenous opening, the intestine carries before it the inner side of the crural sheath and the cribriform fascia ; and, lastly, it receives coverings from the superficial structures of the thigh. The dissection of the thigh may be referred to for fuller detail.

Course and coverings of femoral hernia.

From abdomen it has peritoneum and subperitoneal fat.

Inner part of sheath.

Seat of stricture.—The stricture of a femoral hernia is placed either around or in the neck of the sac, opposite the base of Gimbernat's ligament ; or it is found lower down at the margin of the saphenous opening in the thigh.

Stricture either in neck, or at saphenous opening.

To free the intestine from the constricting fibrous band arching over it, an incision is to be made down to the neck of the sac at the inner and upper part. And to relieve the deep stricture within the neck of the sac, the knife is to be carried horizontally inwards, or upwards and inwards through the thickened sac and a few fibres of the free edge of Gimbernat's ligament.

Incision to divide it.

Danger to vessels.—When the incision is made upwards and inwards to loosen the deep constricting band in the neck of the sac, there will not be any vessel injured unless the cut should be made so long as to reach the spermatic cord, or the small pubic branch of the epigastric artery.

Risk of wounding vessels in regular

And when the incision is made directly inwards with the

and irregular condition of them.

same view, there is not in ordinary cases any vessel in the way of the knife on the inner side of the ring. But in in some few instances (once in about eighty operations, Lawrence), the obturator artery takes its unusual course, lying in front of and on the inner side of the neck of the hernia, and will be before the knife in the division of the stricture. As this condition of the vessel cannot be recognised beforehand, the surgeon will best avoid the danger of wounding the artery by a cautious and sparing use of the knife.

SECTION III.

CAVITY OF THE ABDOMEN.

Definition	The abdominal cavity is the space included between the spinal column behind, and the visceral arches with their intervening muscles in front. It contains the digestive, urinary, and generative organs, with their vessels and nerves.
and contents.	
Dissection to open abdomen.	<i>Dissection.</i> —To prepare the cavity for examination, the remainder of the abdominal wall above the umbilicus is to be divided by a cut along the left side of the linea alba as far as the xiphoid cartilage. The resulting flaps may be thrown to the sides.
Is largest cavity in the body.	<i>Size and form.</i> —This space is the largest in the body. It is oval in form with the ends of the oval upwards and downwards, so that it measures more in the vertical than the transverse direction ; and it is much wider superiorly than inferiorly.
Is oval.	
Above is the diaphragm ; below levator ani.	<i>Boundaries.</i> —Above it is limited by the diaphragm ; and below by the levatores ani, and the structures that close the outlet of the pelvis : both these boundaries are in part fleshy, and concave towards the contents of the cavity, so that the cavity will be diminished by their contraction and flattening. In front and on the sides the parietes are partly osseous and partly muscular :—thus towards the upper and lower limits is the bony framework of the body, viz. the ribs in one direction and the pelvis in the other ; but in the centre are the muscles of the abdominal wall. Behind is the spinal column with the muscles contiguous to it, viz. the psoas and the quadratus lumborum.
In front and on sides, bones and muscles.	
Behind is spine.	
Depth is	<i>Alterations in size.</i> —The dimensions of the cavity are

influenced by the varying conditions of the boundaries. Its depth is diminished by the contraction and descent of the diaphragm, and the contraction and ascent of the levatores ani; and it is restored to its former dimensions by the relaxation of those muscles. The width is lessened by the contraction of the abdominal muscles; and it is enlarged, during their relaxation, by the action of the diaphragm and levatores ani driving outwards the viscera. The greatest diminution of the space is effected by the simultaneous contraction of all the muscular boundaries, as in the expulsion of the excreta.

Its altered by action of diaphragm and levator ani.

Width by muscles in wall of abdomen. How excreta expelled.

Divisions of the space.—An arbitrary division has been made of the space into that of the pelvis and that of the abdomen proper.

Division of space.

The *pelvic* portion is situate below the brim of the pelvis, and contains chiefly the generative and urinary organs.

Pelvic portion.

The *abdominal* portion reaches from the diaphragm to the brim of the pelvis, and lodges the alimentary tube and its appendages, together with the kidneys—the secretory organs of the urine. A serous membrane, the peritoneum, lines the cavity, and covers the viscera.

Abdomen proper.

The following description concerns the part of the cavity between the diaphragm and the brim of the pelvis. Towards the end of the dissection of the abdomen, the pelvic portion will receive a separate notice.

Abdomen proper here described. Pelvis after.

Regions.—The large upper part of the abdominal cavity is divided artificially into regions by lines extended between certain points of the parietes.

Abdominal cavity is

If two circular lines are carried round the body, so that one shall be opposite the cartilage of the ninth rib, and the other on a level with the most prominent point of the crest of the hip bone, the abdominal cavity will be divided into three circles or zones, upper, middle, and lower.

marked out into regions.

Each of these circles may be further subdivided into three by two lines, one on each side, from the cartilage of the eighth rib to the centre of Poupart's ligament. The piece marked off on each side from the three circles by the vertical line is named respectively, from above downwards, hypochondriac, lumbar, and iliac (right and left); whilst the central part of each circle is designated from above down, epigastric, umbilical, and hypogastric.

Lateral

and central.

In addition, the central and lower part of the hypogastric division is named pubic region, whilst its lateral portion is known as the inguinal region.

Parts in
cavity.

Contents and their position.—The alimentary tube and its accessory parts, the liver, pancreas, and spleen, occupy the upper division of the cavity of the abdomen. The kidney is situate also in the same part of the abdominal space.

General
division of
alimentary
tube.

The alimentary tube presents differences in form, and is divided into stomach, small intestine, and large intestine; and each of these portions is further subdivided as it will afterwards appear. The several viscera have the following general position :—

Position of
successive
parts:

The small intestine is much coiled, and occupies the greater part of the cavity; whilst the great intestine arches around it. Both are fixed in position by folds of the serous lining. Above the arch of the great intestine are situate the stomach, the liver, the spleen, and the pancreas; and below it is the convoluted small gut. Behind the large intestine on each side is the kidney with its excretory tube.

of kidney.

Parts of
viscera seen
without
displace-
ment.

Superficial view of the contents.—On first opening the abdomen the following viscera appear :—On the right side is the liver, which is partly concealed by the ribs. On the left side a part of the stomach is visible; but this viscus lies for the most part beneath the ribs, and is somewhat overlaid by the liver. Descending from the stomach is a fold of peritoneum (the large omentum), which reaches to the pelvis, and conceals the intestine. In some bodies the omentum is raised into the left hypochondriac region, and leaves the small intestine uncovered. If the bladder is distended, a small part of it may come into view just above the pelvis.

Connections
of viscera
to be seen.

Before the natural position of the viscera is disturbed, their connections with the surrounding parts, and their situation in the different regions of the abdomen should be examined.

CONNECTIONS OF THE VISCERA.

Position of
stomach.

The stomach (fig. 83).—The stomach intervenes between the gullet and the small intestine, and is retained in position partly by folds of the serous membrane. It is somewhat of a conical form, with the larger end to the left side; and it occupies the left hypochondriac, the epigastric, and part of the right hypochondriac region.

Extremities,
large

At the left end it receives the cesophagus (fig. 83, ^a) by which it is firmly fixed to the diaphragm. Its large end lies beneath the ribs, and is in contact with the spleen, to which it is connected by a fold of peritoneum (splenic omentum): when this part of the stomach is distended it

pushes up the diaphragm, and encroaches on the space for the heart and the left lung. The right extremity ends in the small intestine, and reaches towards the gall bladder; it is in contact with the under part of the liver.

The anterior surface is in contact, from left to right, with the diaphragm, the abdominal wall, and the liver; and the posterior surface corresponds with the pancreas, the pillars of the diaphragm, the aorta and vena cava, and the solar plexus.

The upper border is connected to the liver by a fold of peritoneum, the small omentum; and the lower border gives attachment to another peritoneal fold, the great omentum or epiploon, which floats freely over the intestine.

The form, and the connections of the stomach with the surrounding parts will be influenced by its condition. For when the viscus is empty its surfaces look forwards and backwards, and its borders upwards and downwards; but when distended, it becomes somewhat circular, and makes a rotatory movement, so as to bring forwards the border usually lowest, and to turn upwards that surface which is directed forwards at other times.

The position and connections of the stomach may be changed also by alterations in the size of any of the surrounding organs, or by accumulation of fluid in the chest, or in the belly. The stomach may be dragged down likewise by the great omentum entering a hernial sac, or it may be forced down towards the pelvis by the pressure of tight stays. In these different changes in its position, the right end moves more than the left, because it is attached mostly by peritoneum to the parts around.

The small intestine.—The smaller part of the intestinal tube (*intestinum tenue*) reaches from the stomach to the right iliac region, where it ends in the large intestine. It is divided into three parts, duodenum (twelve fingers intestine), jejunum, and ileum: of the last two, one receives its name from its empty condition, and the other from its numerous coils.

The *duodenum* cannot be satisfactorily seen at present, and it will be examined afterwards (p. 533).

The *jejunum* and *ileum* (fig. 77, ¹, ²) begin on the left side of the second lumbar vertebra, without any distinct mark of separation from the duodenum. Two-fifths of the intestine belong to the jejunum, and the remaining three-fifths to the ileum. This part of the intestinal tube forms many convolutions in the umbilical, hypogastric, lumbar,

Connections.	and iliac regions of the abdomen ; and it descends oftentimes, but more especially in the female, into the cavity of the pelvis. In front of the convolutions is the great omentum ; and posteriorly the small intestine (beyond the duodenum) is fixed to the spine by a fold of peritoneum named the mesentery, which contains the vessels and nerves. Surrounding the jejunum and ileum is the large intestine or colon ; but on the left side of the body the large is concealed by the small intestine.
Large intestine how distinguished.	<i>The large intestine.</i> —The large gut or the colon is sacculated, and is less moveable than the small intestine. It begins in the right iliac region in a dilated part or head (caput cæcum coli), and ascends to the liver through the right iliac, lumbar, and hypochondriac regions. Crossing then the abdomen below the stomach, it reaches the left hypochondriac region ; and it lies in this transverse part of its course between the epigastric and umbilical regions, or altogether in the latter. Finally, it descends on the left side through the regions corresponding with those it occupied on the right, forms a remarkable bend (sigmoid flexure) in the left iliac fossa, and enters the pelvis to end on the surface of the body. It takes an arched course around the small intestine, and is divided into six parts, viz. cæcum, ascending colon, transverse colon, descending colon, sigmoid flexure, and rectum.
Course and extent.	
Divisions.	
Cæcum, or head of colon.	<i>The cæcum</i> (caput cæcum), or the commencement of the colon (fig. 77, ³) is placed in the right iliac fossa, in which it is fixed by the peritoneum being stretched over it. In front usually are the convolutions of the small intestine, but when it is distended it touches the abdominal wall.
Situation and connections.	Behind, it rests on the iliac fascia, only fatty and areolar tissues intervening. On the inner side it is joined by the small intestine ; and it presents inferiorly a worm-like piece—the vermiform appendix. Sometimes the peritoneum surrounds the cæcum, and attaches it by a fold to the abdominal wall.
Ascending colon.	<i>The ascending colon</i> (fig. 77, ⁴) reaches from the cæcum to the under surface of the liver, on the right of the gall bladder. It lies against the quadratus lumborum inferiorly, but higher up it is placed in front of the kidney. To its inner side are the convolutions of the small intestine. The peritoneum fixes the colon immovably to the wall of the abdomen, and surrounds commonly about two-thirds of the circumference ; but it may be found to encircle the tube, and form a fold behind, as in the cæcum.
Parts around.	

The *transverse colon* (fig. 77, ^a) passes obliquely upwards and to the left, along the curvature of the stomach, as far as the spleen; in this course it is deeper at each end than in the middle, and, by being thus bent, forms the arch of the colon. Above the arch are placed the liver and the gall bladder, the stomach and the spleen; and below is the small intestine. In front lies the great omentum; and behind is a fold of peritoneum, the transverse meso-colon, which attaches it to the back of the abdominal wall, and contains the vessels and nerves. The transverse colon is more moveable than any other part of the large intestine, its peritoneal fold allowing it to be raised on the margin of the ribs. Small pieces of peritoneum, containing fat, the appendices epiploicæ, are attached along it.

Connections
of the trans-
verse colon:

is most
moveable
piece of large
intestine.

The *descending colon* (fig. 79, ^a) commences below the spleen, and reaches to the left iliac fossa. At first it is placed deeply in the left hypochondriac region, and is deeper in its whole course than the right colon. In front of it are the convolutions of the small intestine; and behind are the diaphragm, the outer part of the kidney, and the quadratus lumborum. This part of the intestine is smaller than either the right or the transverse portion; and it is less surrounded usually by the peritoneum fixing it to the abdominal wall.

Descending
colon.

Situation.

Is covered
by small
intestine.

The *sigmoid flexure* of the colon (fig. 78, ^a) is situate in the left iliac fossa, to which it is attached by a fold of the peritoneum, the sigmoid meso-colon, but it often extends partly into the cavity of the pelvis. The intestine makes two turns like the letter S, and has obtained its name from that circumstance. It is concealed by the small intestine, which is directed more to the left than to the right side. The extent of this part of the colon is from the crest of the hip bone to the junction of the same bone with the sacrum, where it ends in the rectum.

Sigmoid
flexure

Is in left
iliac fossa.

The *rectum* is the termination of the large intestine, which is contained in the pelvis: it will be seen in the dissection of that cavity.

Rectum.

The *liver* (fig. 79, ¹).—The liver is situate in the right hypochondriac, and epigastric regions, and reaches slightly into the left hypochondriac. Folds of peritoneum (ligaments) retain it in place.

Position of
the liver.

The upper surface, convex, is turned to the vault of the diaphragm, and is divided into two parts by the suspensory ligament; the right portion, more prominent than the left, reaches to the level of the fifth intercostal space.

Surfaces.

The under surface is in contact with the stomach and the duodenum, with the ascending colon, and with the right kidney and suprarenal body. Attached to this surface is a fold of the peritoneum (small omentum) containing the hepatic vessels.

Borders.

The anterior border is thin, and is constantly varying its position to the wall of the thorax according to the distension of the stomach, and the position of the body and the diaphragm. This edge, except a small part near the xiphoid cartilage, lies in adult males usually within the margin of the ribs, but in women and children it reaches below that line. The gall bladder projects beyond this edge. The posterior border is thick, and is connected to the diaphragm by certain ligaments or folds of the peritoneum: it lies on the large vessels (aorta and cava), and on the pillars of the diaphragm.

Position is changed by diaphragm, by posture of body,

The liver is constantly changing its situation with the ascent and descent of the diaphragm in respiration; thus in inspiration it descends, and in expiration it regains its former level. In the upright and sitting postures this viscus descends lower than in the horizontal condition of the body; so that when the trunk is erect, the anterior border may be felt underneath the edge of the ribs, but when the body is reclined it is withdrawn within the margin of the thorax. The connections of the liver with the surrounding parts may be changed by the growth of tumours, by collections of fluid in the chest or in the abdomen, or by constricting the space for its lodgment, as in tight-lacing.

and by disease in other parts.

Situation of the spleen.

The spleen (fig. 79, ³).—The spleen lies deeply in the left hypochondrium, between the stomach and the ribs, and is connected by peritoneum to the great end of the stomach on the one side, and to the diaphragm on the other. Its position is almost vertical. The outer surface is convex; it touches the diaphragm, and is opposite the ninth, tenth, and eleventh ribs. At the inner surface, which is concave, the vessels enter, and to it a fold of peritoneum, the gastro-splenic omentum, is attached: the part in front of the vessels touches the stomach; and the part behind them is in contact with the left crus of the diaphragm, the suprarenal capsule, and the tail of the pancreas. Below the spleen are the kidney and the beginning of the descending colon. When the stomach is distended the spleen is somewhat behind it.

Connections.

Kidney

The kidney.—The kidney should be examined on the left side of the body, so that the duodenum may not be displaced.

In order that it may be seen, the descending colon and the peritoneum must be separated from the abdominal wall. This viscus is surrounded with fat, and is situate in the lumbar region opposite the last dorsal, and the upper two or three lumbar vertebrae. Its position is somewhat oblique, and the upper is nearer than the lower end to the spinal column. In front of the kidney are the peritoneum and the colon; and behind it are the quadratus lumborum and psoas muscles, with the diaphragm and the last rib. Above each kidney and resting on it, is the suprarenal capsule; and below each is the iliac crest. The inner border looks to the spine and receives the vessels; whilst the outer border projects towards the side of the abdominal wall. Sometimes the two are united in front of the aorta, and form the horse-shoe kidney.

occupies
lumbar
region.

Parts in
front,
behind,
above,
below,
inside.

Difference on opposite sides.—The right kidney is placed rather lower than the left; it reaches as high as the lower border of the last rib but one, whilst its fellow is opposite the upper border of the corresponding rib. In front of the right, in addition to the common connections before specified, is the duodenum; and before the left one is the lower end of the spleen. Above the right is the liver, and above the left the spleen.

Right
highest.

Different
parts before

and above.

The connections of the *pancreas* may be omitted for the present. This viscus is described at page 534.

Pancreas
after.

THE PERITONEUM.

This is the largest serous membrane in the body. Like other membranes of the kind it is a closed sac in the male, but in the female its cavity is continuous with the canals of the Fallopian tubes. One part of it lines the wall of the abdomen (parietal layer), and another is reflected over the different viscera (visceral layer) except where the vessels enter. The inner surface is smooth; but the outer is rough, when it is detached from the parts with which it is naturally in contact. The membrane forms folds as it passes from viscus to viscus along the vessels; and the folds attaching the viscera to the abdominal wall, consist for the most part of two layers, one on each side of the vessels.

consists of a
parietal and
visceral
layer,

and forms
folds on
vessels.

The continuity of the sac may be traced in both a horizontal and a vertical direction.

Horizontal circle around the abdomen.—If the membrane be followed outwards from the umbilicus, it will be found

Circle of the
membrane

opposite
umbilicus.

to surround partly the large intestine and to fix it to the abdominal wall. From the colon it may be traced over the kidney as far as the middle line, where it is reflected over the small intestine, and along the front and back of the vessels supplying the gut. Lastly it may be pursued outwards to the right kidney and the colon which it encircles like the left, and then along the wall of the abdomen to the umbilicus. The membrane fixing the colon on each side to the abdominal wall, is named meso-colon, and that attaching the small intestine is the mesentery.

Circle from
above down;

Vertical circle, or from above downwards.—From the liver the peritoneum may be followed along the vessels at the under surface to the upper border of the stomach, one piece before and the other behind them, the two forming the small omentum. At the stomach the two pieces separate, one going before, and the other behind it; but beyond that viscus they are applied to each other to form the great omentum or epiploon. After descending in contact in the omentum to the lower part of the abdomen, they may be traced backwards and upwards, and may be seen to separate to enclose the transverse colon like the stomach; and then to continue to the spine, giving rise to the transverse meso-colon. At the attachment of the transverse meso-colon to the abdominal wall, the two companion pieces will be found to separate,—one passing upwards, the other downwards:—

forms
omentum,

bounding
the pouch,

The ascending piece is continued in front of the pancreas and the pillars of the diaphragm, and blends with the peritoneum on the under surface of the liver behind the vessels. By its ascent it forms the posterior part of a pouch behind the stomach.

and de-
scends over
the intestine
to the
pelvis.

The descending piece or layer may be followed from the transverse meso-colon along the middle line of the spine, over the duodenum and the great vessels on the spine (aorta and cava), till it meets with the artery to the small intestine along which it is continued to form the mesentery, as before explained in tracing the peritoneum in a circular direction. From the root of the mesenteric artery the peritoneum descends to the pelvis, and covers partly the viscera in that cavity.

In the pelvic
cavity

Surrounding the upper part of the rectum, it attaches this viscus to the abdominal wall by the meso-rectum; next, it is continued forwards between the rectum and the bladder, or between the rectum and the uterus, where it forms a pouch; thence it passes from the pelvis over the back and sides of the bladder.

Lastly, the serous membrane is continued to the inguinal region, where it presents the pouches before alluded to (p. 507); and it can be traced upwards on the wall of the abdomen and over the diaphragm and liver to the under surface of that viscus in front of the vessels.

Folds of the peritoneum.—After tracing the continuity of the serous sac over the viscera, the student is to learn the chief folds or processes of the membrane in connection with the alimentary tube. The pieces of the peritoneum fixing the liver will be examined afterwards: and the folds on the viscera of the pelvis will be seen with the dissection of that cavity.

Folds on the stomach.—The processes of the serous membrane connected with the stomach are named omenta. They are three in number:—one, small omentum, is attached to the upper curve; another, great omentum, to the lower curve; and the third, splenic omentum, is fixed to the great end of the viscus.

The *small* or *gastro-hepatic omentum* is stretched between the under surface of the liver and the upper border of the stomach, and contains the vessels and nerves of the liver. It is formed by two pieces of peritoneum, as before explained, and presents a free border on the right side. Behind it is the space called foramen of Winslow. Its lower border is fixed to the small curve of the stomach; whilst its upper border is attached to the transverse fissure, as well as to the posterior half of the longitudinal fissure of the liver, blending with the left lateral ligament of the viscus.

The *gastro-colic* or *great omentum* is the largest fold of the peritoneum, and consists of two pieces, which are continuous with the membrane on the front and back of the stomach. It is attached above to the spleen and the lower border of the stomach, and descends in front of the intestine, but lower on the left than the right side of the body. At the lower part of the abdomen the fold is bent backwards, and returns towards the spine, the pieces of which it is composed separating and enclosing the transverse colon as before seen. Between its layers are contained some fat, and some vessels and nerves; and the power of separating the one layer from the other diminishes with the increase of the distance from the stomach, until at last they are not to be separated, and the membrane they form is thin and net-like.

The anterior part of the omental fold is separated from

the posterior by a space (bag of the omentum), which extends a varying distance.

Bag of the omentum.

Boundaries.

Opens into general cavity by foramen of Winslow.

Parts covered or formed by it.

Foramen of Winslow.

Splenic omentum.

Peritoneum

Cavity or sack of the great omentum.—When an opening is made through the great omentum near the stomach, and this viscus is raised, a space is seen to extend upwards to the liver, and downwards into the omentum. This is the omental sack. In front the space is bounded by the small omentum, the stomach, and the anterior part of the great omentum. Behind it are the posterior part of the great omentum, the transverse colon, and the transverse meso-colon with its ascending layer. Above is the liver; and below is the doubling of the omental fold.

This space communicates with the rest of the peritoneal cavity, through the hole (foramen of Winslow), behind the small omentum. If the sack of the omentum were perfect, it could be inflated through the foramen; or if it were detached from the surrounding parts, it could be drawn through the same hole into the general bag of the peritoneum.

Supposing it to be detached and drawn out, the following parts would have peritoneum taken from them, viz. the small omentum (posterior piece), the posterior part of the stomach, the great omentum (inner piece), the upper surface of the transverse colon, the pancreas, the spine, and the posterior part of the liver. Should this piece of peritoneum be removed, there is not any membrane to prevent the vessels reaching the different viscera; and it may be readily conceived how the peritoneum could be replaced over the viscera, and around the vessels without being perforated by them.

The *foramen of Winslow* is the space behind the small omentum, through which the bag of the great omentum opens into the general cavity of the peritoneum. In front of it is the small omentum, and behind are the vena cava and the spine. Above it is the liver (lobulus Spigelli), and below is the duodenum. Should this hole be closed by inflammation, a dropsical effusion would be confined to the sack of the omentum, and so be shut out from the general bag of the peritoneum.

The *splenic omentum* reaches from the great end of the stomach to the concave surface of the spleen, and does not consist usually of two strata or pieces, like the other omenta. It covers the vessels passing between the two viscera, and is continued inferiorly into the great omentum.

Folds on the large intestine.—The large intestine is con-

nected to the wall of the abdomen by folds of the peritoneum (meso-colic), which are formed of two pieces like the other processes. Each part of the colon has a separate meso-colon attaching it: thus there is an ascending, a transverse, a descending, and a sigmoid meso-colon. The cæcum is fixed also by a meso-cæcum, and the rectum by a meso-rectum.

The *meso-cæcum* attaches the caput cæcum coli to the right iliac fossa. Usually the peritoneum does not surround the gut so as to form a fold behind it, but in some bodies the serous membrane does give a suspensory process to this part of the intestine.

By the *ascending* and the *descending meso-colon* the ascending and the descending part of the colon are kept in place. In these folds, as in that of the cæcum, the peritoneum does not commonly surround the intestine, though it may meet behind and form processes.

The *transverse meso-colon* is a more perfect fold than either of the others connected with the large intestine, and serves as a partition between the small intestine and the stomach, liver, and spleen. By one side it is fixed to the colon, and by the other side to the abdominal wall below the pancreas. It is formed of two layers of peritoneum, as before said, which enclose the vessels of the colon.

The *sigmoid meso-colon* is a long process of the serous membrane, and attaches the sigmoid flexure of the colon to the left iliac fossa.

The *meso-rectum* contains the hæmorrhoidal vessels, and connects the rectum to the front of the sacrum.

Small processes of the peritoneum are attached along the tube of the great intestine, chiefly to the transverse colon; they are the *appendices epiploicæ*, and contain fat.

Folds of the small intestine.—The small intestine is not enveloped by the peritoneum after the same manner through all its extent. For whilst the jejunum and ileum are attached to the abdominal wall by one fold (mesentery), the duodenum has special connections with the serous membrane.

Serous covering of the duodenum.—The first part of the duodenum is surrounded by peritoneum, like the stomach. The second part is covered only in front. And the last part, which crosses the aorta, is but slightly in contact with the serous membrane, for it lies at first between the strata of the transverse meso-colon, and then beneath the upper part of the superior mesenteric artery.

- Mesentery.** *Fold of the jejunum and ileum.*—The *mesentery* supports the rest of the small intestine, and is stronger than any other fold of the serous membrane. Its inner end is narrow, and is attached to the spine from the left side of the second lumbar vertebra to the junction of the right hip bone with the sacrum. The other end of the fold is wide, and is connected with the intestine. Between its two layers are the superior mesenteric vessels and nerves, with lymphatic glands and lacteals.
- Form.**
- Attachments.**
- Parts contained in it.**
- Peritoneal folds of the liver.** *Ligaments of the liver.*—The reflections of the peritoneum between the liver and the wall of the abdominal cavity are named ligaments. Along the upper part is a suspensory fold containing the obliterated umbilical vein; and there is a coronary ligament along the posterior border.
- Suspensory ligament.** The *suspensory* or *falciform ligament* is placed between the upper convex surface of the liver and the parietes of the abdomen. It is falciform in shape; and in the recumbent position of the body, its base is turned forwards, and apex backwards. The lower border is concave, and is attached to the liver; whilst the upper border is convex, and is connected to the abdominal wall on the right side of the linea alba, and to the under part of the diaphragm. In its base or free part is contained the remnant of the umbilical vein, which is named the *round ligament*. This fold allows the passage of the umbilical vein to the liver without piercing the bag of the peritoneum; and with a little care the dissector will be able to detach the serous membrane from the vein, and to trace it continuously upwards on each side into the suspensory ligament.
- Shape.**
- Attachments.**
- Contains round ligament.**
- How formed.**
- Coronary ligament** The *coronary ligament* is a short but wide process of the peritoneum, which connects the hinder part of the liver to the diaphragm. It reaches all across the liver, but at each side it is enlarged, and forms a triangularly shaped piece; to these larger pieces of it the terms right and left lateral ligaments have been applied.
- gives rise to left and** *a. The left lateral ligament* is attached to the liver above the edge of the left lobe, and is formed by two pieces of peritoneum, which are in contact; it lies in front of the cesophagean opening in the diaphragm.
- right lateral ligaments.** *b. The right lateral ligament* lies deeply in the hypochondriac region, in front of the vena cava inferior. Its two pieces of peritoneum are widely separated from one another, and between them the kidney touches the liver.

MESENTERIC VESSELS AND SYMPATHETIC NERVE.

Directions.—The vessels and nerves (mesenteric) which are distributed to the greater part of the alimentary tube, may be first dissected. After these have been examined, and the connections of the aorta and vena cava have been seen, most of the intestine can be taken out to give room for the display of the viscera in the upper part of the cavity.

Examine first vessels to intestine.

MESENTERIC VESSELS.—The superior and inferior mesenteric arteries are two large visceral branches of the aorta, which supply the intestine, except part of the duodenum and lower extremity of the rectum. Each is accompanied by a vein, and by a plexus of nerves of the same name derived from the sympathetic.

Vessels of intestine.

Dissection.—For the dissection of the superior mesenteric vessels and nerves, the great omentum and the transverse colon are to be placed on the margin of the ribs (fig. 77), and one layer (anterior) of the mesentery is to be removed. Whilst tracing the branches of the artery to the small intestine the student will meet with corresponding veins, and with offsets of the sympathetic nerves on the arteries. Some mesenteric glands and a few lacteal vessels will come into view at the same time. The branches from the right side of the vessel to the large intestine are to be next followed. After all the branches have been cleaned, the trunk of the artery should be traced back beneath the pancreas (*f*), and the plexus of nerves surrounding it should be defined.

Dissection of superior mesenteric.

The *superior mesenteric artery* (fig. 77, *a*) supplies branches wholly to the small intestine beyond the duodenal part, and to half the large intestine, viz., as far as the end of the transverse colon (*f*). Arising from the aorta near the diaphragm, the vessel is directed downwards between the layers of the mesentery, where it forms an arch with the convexity to the left side, and terminates in offsets to the cæcum and the end of the small intestine. At first the artery lies beneath the pancreas and the splenic vein; and as it descends to the mesentery it is placed in front of the duodenum (¹) and the left renal vein. This vessel is surrounded by the mesenteric plexus of nerves, and is accompanied by the vein of the same name.

Superior mesenteric artery.

Courses to intestine in the mesentery.

Connections

Branches.—Whilst the vessel is covered by the pancreas it gives a small branch to that body and the duodenum. Its

branches.

other branches are intestinal : those from the left or convex side of the vessel (*rami intestinales*) supply the jejunum and the ileum ; and those from the opposite side supplying the colon are named *colic arteries*.

Fig. 77.*



Pancreatico-
duodenal.

The *pancreatico-duodenal branch* (inferior) is of small size (fig. 77, *e*), and after giving twigs to the pancreas, extends from left to right along the concavity of the duodenum, and anastomoses with the other duodenal branches.

Branches to
small intestine.

The *intestinal branches* to the jejunum and the ileum (*a*) are about twelve in number, and pass from the left side of the artery between the layers of the mesentery to their

* Superior mesenteric artery and its branches.—1 to 2. Jejunum and ileum. 3 to 6. Colon. 7. Pancreas. A. Trunk of the superior mesenteric artery. *a. a.* Intestinal branches from the left side. *b.* Ileo-colic branch. *c.* Right colic branch. *d.* Middle colic branch. *e.* Pancreatic branch.

destination. About two inches from their origin or sooner the branches bifurcate, and the resulting pieces unite with similar offsets from the collateral arteries so as to form a series of arches. From the convexity of the arches other branches take origin, which divide and unite in the same way. This process is repeated four or five times between the origin and the distribution of the arteries, but at each branching the size of the vessels diminishes. From the last set of arches twigs are sent to the intestine on both aspects of the tube, and anastomose round it supplying the structure.

Number and arrangement in arches.

Distribution on the gut.

The branches to the large intestine are three in number, ileo-colic, right colic, and middle colic arteries.

Arteries of large gut.

a. The *ileo-colic artery* (b) arises from the right side of the mesenteric trunk. It descends to the cæcum, and divides into branches that encircle the head of the colon, as in the small intestine. A descending offset is distributed to the lower part of the ileum, the cæcum, and the vermiform appendix; whilst an ascending offset supplies the beginning of the ascending colon, and anastomoses with the right colic artery.

Ileo-colic branch

ends on cæcum.

b. The *right colic artery* (c) is commonly an offset of the preceding, instead of a separate branch from the trunk. Its course is to the right or ascending colon. Near the intestine it divides into an ascending and a descending piece, and anastomoses with the ileo-colic artery on the one side, and the middle colic on the other. This artery gives ramifications to the ascending colon.

Right colic branch supplies ascending colon.

c. The *middle colic branch* (d) arises from the upper part of the superior mesenteric artery, opposite the transverse meso-colon. Entering between the layers of that fold of the peritoneum, the vessel divides into two large diverging branches:—the right branch anastomoses with the artery to the ascending colon, and the left inosculates on the descending colon with a branch (left colic (e)) of the inferior mesenteric artery. The intestinal twigs to the transverse colon are supplied from the two terminal pieces, but before entering the gut they are united in arches like those to the small intestine.

Middle colic branch passes to transverse colon.

They form arches.

The *superior mesenteric vein* (fig. 79, e) commences in that part of the intestinal tube to which the artery is distributed, and its radicles unite into one trunk. Thus formed, the vein accompanies the artery beneath the pancreas, and there joins the splenic vein to form the vena portæ.

Superior mesenteric vein.

The *mesenteric lymphatic glands* are numerous between

Mesenteric glands.

the layers of the mesentery, and are lodged in the intervals between the vessels.

Meso-colic glands.

Along the large intestine are a few other lymphatic glands, *meso-colic*, which receive the lymphatics of the large intestine.

Lymphatics entering them.

The lactiferous or chyliferous vessels of the small intestine, and the lymphatics of the part of the large intestine supplied by the superior mesenteric artery, pass through the mesenteric glands to reach the thoracic duct.

Dissection of inferior mesenteric.

Dissection.—By drawing the small intestine over to the right side, the dissector will perceive the inferior mesenteric

Fig. 78.*



artery on the front of the aorta a little above the bifurcation (fig. 78). The peritoneum should be removed with care

* Inferior mesenteric artery and its branches.—1 to 4. Left half of the colon. 5. Small intestine. 6. Pancreas. *d.* Inferior mesenteric artery. *e.* Left colic branch. *f.* Sigmoid branch. *g.* Superior hæmorrhoidal branch. *a* to *c.* Superior mesenteric artery and its branches as in fig. 77.

from it, and the branches should be traced outwards to the remaining half of the large intestine : a part of the artery enters the pelvis, but this will be dissected afterwards. On the artery and its branches is the inferior mesenteric plexus of nerves. The mesenteric vein is to be followed upwards to its junction with the splenic, or with the superior mesenteric vein. On the aorta the dissector will meet with a plexus of nerves which is to be left uninjured.

The *inferior mesenteric artery* (fig. 78, *d*) supplies branches to the part of the large intestine beyond the transverse colon, and communicating with the superior mesenteric, assists to maintain the chain of anastomosis along the intestinal tube. This vessel is of smaller size than the superior mesenteric, and arises from the aorta from one to two inches above the bifurcation. At first the vessel descends on the aorta, and crosses the left common iliac artery in its course to the pelvis, where it ends in branches to the rectum (superior hæmorrhoidal). The following *branches* are furnished by it to the descending colon and the sigmoid flexure.

The *left colic artery* (*e*) ascends in front of the left kidney, and divides into an ascending and a descending branch for the supply of the descending colon. By the ascending offset it anastomoses with the middle colic branch of the superior mesenteric artery.

The *sigmoid artery* (*f*) is distributed to the sigmoid flexure. Passing almost transversely outwards it divides into branches which anastomose above with the preceding colic branch, and below with the hæmorrhoidal. Here, as in the rest of the intestinal tube, arches are formed by the arteries for the supply of the intestine.

The *superior hæmorrhoidal artery* (*g*) enters between the layers of the meso-rectum, and is distributed to the lower part of the great intestine : it will be described in the dissection of the pelvis.

The *inferior mesenteric vein* (fig. 79, *d*) begins in the part of the great intestine to which its companion artery is distributed, and ascends along the psoas muscle, away from the artery, to open into the splenic vein beneath the pancreas. Occasionally it joins the superior mesenteric vein.

The mesenteric veins are without valves, and may be injected from the trunk to the branches like an artery.

Lymphatic glands are found by the side of the descending colon and the sigmoid flexure. The lymphatics from the intestine, after passing through the glands, enter the left lumbar lymphatic glands.

Inferior mesenteric artery.

Place of origin.

Course and branches.

Left colic branch to the descending colon.

Sigmoid branch

to sigmoid flexure.

Branch to rectum.

Inferior mesenteric vein.

Veins of intestine without valves.

Lymphatic glands.

Some
plexuses of
the sym-
pathetic to the
viscera.

SYMPATHETIC NERVE.—The plexuses of the sympathetic, which are derived from the solar plexus beneath the stomach, viz., superior mesenteric, aortic, spermatic, inferior mesenteric, and hypogastric, are to be seen with the vessels. The remaining portion of the sympathetic nerve in the abdomen will be subsequently referred to.

Dissection.

Dissection.—On the two mesenteric arteries the dissector will have made out already the plexuses of nerves distributed to the intestinal tube beyond the duodenum.

Aortic
plexus.

He has now to trace on the aorta itself the connecting nerves between the mesenteric plexuses. By taking the peritoneum from the aorta between the mesenteric vessels, the aortic plexus will appear. From the upper part of this plexus an offset is to be followed along the spermatic artery; this may be done, on the left side, where the vessel is partly laid bare.

Hypogastric
plexus.

By removing the serous membrane from the front of the sacrum, and following downwards, over the iliac arteries, the nerves from the aortic plexus and the lumbar ganglia, the dissector will arrive at the hypogastric plexus of the pelvis opposite the top of the sacrum.

Superior
mesenteric
plexus

is on artery
of same
name.

The *superior mesenteric plexus* is a large offset on the mesenteric artery and its branches, and is distributed to the same extent of the intestinal tube as the vessel. The nerves surround closely the artery with a sheath, and are covered at first by the pancreas. In the mesentery near the intestine some of the nerves leave the arteries, and divide and communicate with others before entering the gut.

Its
secondary
plexuses.

Branches.—The secondary plexuses are the same as the offsets of the artery, viz., intestinal nerves to the small intestine; and an ileo-colic, a right colic, and a middle colic plexus to the large intestine.

Aortic
plexus is
derived
from solar
plexus.

Offsets.

The *aortic plexus* is the network of nerves covering the aorta below the superior mesenteric artery. Superiorly it is continuous with the solar plexus; and inferiorly it ends on each side in branches, which cross the common iliac artery, and enter the hypogastric plexus of the pelvis. From it offsets are furnished to the two visceral branches of the aorta below the renal and superior mesenteric trunks, viz., to the spermatic and inferior mesenteric arteries.

This plexus
is best
marked on
sides of
aorta.

The aortic plexus is stronger on the sides than on the front of the aorta, in consequence of its receiving accessory branches from the lumbar ganglia, especially the left. At the upper part the plexus seems to be derived from an offset,

on each side of the aorta, which is connected with the solar and renal plexuses.

The *spermatic plexus* is formed by roots from both the aortic and the renal plexus. The nerves from it run on the spermatic artery to the testicle; and in the cord they join other filaments on the vas deferens. Spermatic plexus.

In the female, the nerves on the ovarian (spermatic) artery are supplied to the ovary and the uterus. In female.

The *inferior mesenteric plexus* surrounds the trunk and branches of the artery of the same name, and supplies the same part of the intestinal tube as the artery. This plexus is furnished from the left part of the aortic plexus; and the nerves composing it are whiter and larger than in either of the preceding offsets of the sympathetic. Near the intestine (sigmoid flexure) the branching of the nerves, and the union of contiguous twigs, are well marked. Inferior mesenteric plexus.
Nerves join like the vessels.

Branches.—The following secondary plexuses are named from the arteries they accompany, and are distributed like them to the intestine, viz., the left colic, the sigmoid, and the superior hæmorrhoidal plexus. Secondary plexuses.

On the intestinal tube the nerves of one plexus join those of another. Thus the superior mesenteric joins by one end the nerves to the duodenum, and by the other the nerves to the large intestine from the inferior mesenteric plexus. And the inferior mesenteric nerves communicate below with branches to the rectum from the pelvic plexus. Union of the nerves on the intestinal tube.

The *hypogastric plexus*, or the large prevertebral centre for the supply of sympathetic nerves to the viscera of the pelvis, is situate in front of the upper part of the sacrum and beneath the peritoneum. It is developed more on each side than in the centre; and the nerves, which are large and flat, have a plexiform arrangement, but without any ganglionic masses on them. By its upper part the plexus receives on each side the termination of the aortic plexus; and it is joined by some filaments from one or two of the upper sacral ganglia. Inferiorly the plexus ends in two parts, right and left, the last being the largest, which are continued forwards with the branches of the internal iliac artery to the pelvic plexuses and the viscera. Hypogastric plexus.
Situation.
In it aortic plexus ends;
and from it offsets are sent to pelvic viscera.

CONNECTIONS OF THE AORTA AND VENA CAVA.—The connections of the *abdominal aorta* and of the *vena cava* may be next looked to, before the viscera are removed from the body. Parts around aorta and cava.

Dissection.—The part of the abdominal aorta below the origin of the superior mesenteric artery has been laid bare Dissection.

by the previous dissection. To see the vessel higher up, it will be necessary to detach the great omentum from the stomach, without injuring the gastro-epiploic artery, and after raising the stomach and the spleen, to remove the peritoneum from the surface of the pancreas. A short arterial trunk (coeliac axis) above the pancreas is not to be cleaned now, otherwise the nerves about it would be destroyed. The vena cava may be dissected at the same time as the aorta.

Aorta lies in middle of spine.

The *aorta* enters the abdomen between the pillars of the diaphragm, and divides into iliac arteries opposite the left side of the fourth lumbar vertebra. At the diaphragm the vessel occupies the middle line of the spine, but it gradually inclines to the left as it descends.

Parts around.

In the abdomen the aorta is covered at first by the solar plexus, and by the pancreas and the splenic vein; still lower (beyond the superior mesenteric artery) by the left renal vein and the duodenum; and thence to its termination by the peritoneum and the aortic plexus. The vessel lies on the lumbar vertebrae; and to its right side is the vena cava. Its *branches* are furnished to the viscera and the wall of the abdomen, but these will be enumerated further on.

Branches.

Vena cava; extent:

The *vena cava inferior* commences on the right side of the fifth lumbar vertebra by the union of the common iliac veins, and reaches from that spot to the heart.

connections; is by the side of the aorta, except above.

In the abdomen this venous trunk is placed on the right side of the vertebral column. It lies close to the aorta, and is concealed by the same parts as high as the crus of the diaphragm; but above that spot it is inclined away from the artery, and ascending on the right of the crus, is imbedded in the posterior part of the liver. Lastly, it leaves the abdomen by an aperture in the tendinous centre of the diaphragm, on the right of the aortic opening. The vena cava is joined by some *branches* from the abdominal viscera, and by others corresponding with the branches of the aorta that are supplied to the parietes of the abdomen.

Branches.

CONNECTIONS OF THE DUODENUM AND PANCREAS.

Directions.—The situation, and the connections of the duodenum and pancreas should be looked to next.

Remove intestine

Dissection.—To see satisfactorily the duodenum and the pancreas, the intestinal tube, beyond the duodenum, is to be removed in the following way:—a double ligature is to be

placed on the upper part of the jejunum, another on the lower end of the sigmoid flexure of the colon, and the gut is to be cut through at the points at which it is tied. The detached piece of the intestinal tube can be taken away by cutting through the vessels and the peritoneum connecting it to the wall of the abdomen; after it has been separated, it is to be set aside for future study whilst the body is turned.

To render the remaining viscera fit for examination, the student should moderately inflate the stomach and duodenum from the cut extremity of the latter, and remove the peritoneum and fat; whilst cleaning them, he should be careful of the vessels and nerves.

On turning upwards the stomach he will be able to trace the pancreas from the spleen on the one hand to the duodenum on the other; and on raising the duodenum, the common bile duct may be found between it and the head of the pancreas.

DUODENUM (fig. 84, *d*).—The first part of the small intestine, or the duodenum, begins at the pyloric end of the stomach, and crossing the spinal column, ends on the left side of the second lumbar vertebra. It makes a curve around the head of the pancreas, and occupies the right hypochondriac, right lumbar, and umbilical regions of the abdomen. Its peritoneal covering is incomplete and peculiar (p. 523). From its winding course around the pancreas it is divided into three parts—superior transverse, vertical, and inferior transverse.

The *superior transverse* part is free and moveable, like the stomach; it measures about two inches in length, and is directed from the pylorus to the neck of the gall bladder, ascending slightly in its progress from the one point to the other. In front it is overlapped by the liver, as well as by the gall bladder when this is distended; and behind it are the bile duct and the vena portæ.

The *vertical part* is fixed almost immovably by the peritoneum and the pancreas. It is nearly three inches in length, and descends from the gall bladder as far as the third lumbar vertebra. Superficial to this part is the right bend of the colon; and beneath it are the kidney and its vessels. On its inner side is the head of the pancreas, with the common bile duct. The ducts of the pancreas and liver pour their contents into this piece of the duodenum.

The *inferior transverse part* is the longest of the three, The third

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The *superior transverse* part is free and moveable, like the stomach; it measures about two inches in length, and is directed from the pylorus to the neck of the gall bladder, ascending slightly in its progress from the one point to the other. In front it is overlapped by the liver, as well as by the gall bladder when this is distended; and behind it are the bile duct and the vena portæ.

The *vertical part* is fixed almost immoveably by the peritoneum and the pancreas. It is nearly three inches in length, and descends from the gall bladder as far as the third lumbar vertebra. Superficial to this part is the right bend of the colon; and beneath it are the kidney and its vessels. On its inner side is the head of the pancreas, with the common bile duct. The ducts of the pancreas and liver pour their contents into this piece of the duodenum.

The *inferior transverse part* is the longest of the three, The third

to see the duodenum,

and pancreas.

Extent of duodenum; course and situation.

Division.

First part is shortest, and is moveable.

Second part is fixed,

and rests on the kidney.

end communicate with twigs (*vasa brevia*) of the splenic artery.

Splenic
artery

2. The *splenic artery* is the largest branch of the celiac axis in the adult. It is a tortuous artery, and runs almost horizontally to the spleen, along the upper border of the pancreas. Near the spleen it divides into terminal branches (*splenic*), which are about six in number (from four to ten), and enter the substance of that viscus by the concave surface towards the stomach. In its course the vessel is accompanied by the splenic vein, which is below it, and it distributes branches to the pancreas and the stomach.

supplies the
spleen,

the pancreas
by large and
small twigs,

a. Pancreatic branches.—Numerous small branches are supplied to the gland as the artery lies along it: and one of these, *art. pancreatica magna*, arises near the left end of the gland, and runs to the right with the duct in the substance of the viscus.

and the
stomach

b. The branches for the stomach arise from the divisions of the artery near the spleen.

by *vasa
brevia*;

Some of these, *vasa brevia*, turn upwards to the left end of the stomach, beneath or between the layers of the gastro-splenic omentum, and ramify in the coats of that organ.

and left
gastro-
epiploic.

Another branch, *art. gastro-epiploica sinistra*, which is larger than the others, turns to the right between the layers of the great omentum along the great curvature of the stomach, and inosculates with the right gastro-epiploic branch of the hepatic artery. This artery distributes twigs to both surfaces of the stomach, as well as others between the pieces of peritoneum forming the great omentum.

Hepatic
artery;

3. The *hepatic artery* is the largest in the fetus of the three branches into which the celiac axis divides; but in the adult it is intermediate in size between the other two, and is encircled by the largest plexus of nerves. In its course to the liver the vessel is bent first to the right towards the small end of the stomach, where it supplies its principal branches (superior pyloric and gastro-epiploic). It ascends then between the layers of the little omentum, on the left side of the bile duct and vena portæ, and divides near the transverse fissure of the liver into two large terminal arteries—the right and left hepatic. Its branches are distributed not only to the liver, but freely to the stomach, the duodenum, and the pancreas.

courses to
the liver,

in which it
ends,

and supplies

offsets to
the stomach.

a. The superior pyloric branch descends to the upper border of the stomach, and running from right to left anastomoses with the coronary artery; it distributes small

arterial twigs on both the anterior and posterior surfaces of the stomach.

*b. The right gastro-epiploic branch** (art. gast. epiploica dextra) is a trunk of considerable size, which descends beneath the duodenum near the pylorus, and turning from right to left along the great curvature of the stomach between the pieces of the great omentum, inosculates with the left gastro-epiploic branch of the splenic artery. On the surfaces of the stomach some offsets are given upwards, and others downwards between the layers of the omentum. It furnishes the following branches to the stomach, and the pancreas and duodenum :—

Small *inferior pyloric* branches end in the small extremity of the stomach. inferior pyloric,

The *pancreatico-duodenal branch* (superior) arises opposite the duodenum, and runs along the curve of the intestine, lying between it and the pancreas ; it anastomoses below with the pancreatico-duodenal branch (inferior) of the superior mesenteric artery (fig. 77, *e*). Both the duodenum and the pancreas receive offsets from this vessel. On the posterior aspect of the viscera is another small offset with a similar position and distribution. and pancreatico-duodenal.

c. The hepatic branches (right and left) sink into the liver at the transverse fissure, and ramify in its substance :— Branches to the liver ;

The *right branch* is divided when about to enter the transverse fissure of the liver, and supplies the following small artery to the gall bladder. The *cystic* artery, on reaching the neck of the gall bladder, divides into two twigs which ramify on the opposite surfaces, and are distributed to the coats. one for the right lobe and gall bladder,

The *left branch* is smaller than the other, and enters the liver at the left end of the transverse fissure. A branch to the Spigelian lobe of the liver arises from this piece of the artery. and one for the left lobe.

VEINS.—The named visceral veins of this part of the abdomen are three in number, viz., the superior coronary, the splenic, and the portal vein. Three visceral veins, viz.—

The *superior coronary vein* (fig. 79) lies along the upper border of the stomach. It begins in the œsophagus and the left part of the stomach, and joins the vena portæ at the pylorus. coronary from the stomach ;

The *splenic vein* (fig. 79, *b*) is of large size, and is formed splenic from the spleen,

* This artery is named commonly gastro-duodenal as far as to the spot where it gives off the branch to the duodenum and pancreas.

side of the vertebral column ; and of prevertebral centres or plexuses, which furnish branches to the viscera.

Two large
centres,
solar

and hypo-
gastric.

Two prevertebral plexuses are found in the abdomen. One of these is the solar or epigastric plexus, which is placed behind the stomach, and supplies nerves to all the viscera above the cavity of the pelvis. The other, or the hypogastric plexus, is situate in the pelvis, and distributes nerves to the pelvic viscera. The offsets or the secondary plexuses of these centres accompany the bloodvessels to the viscera.

The knotted or gangliated cord will be seen in a subsequent stage of the dissection ; and only the great epigastric centre, viz., the solar plexus and the semilunar ganglion with their offsets, is to be now prepared.

How to lay
bare solar
plexus,

Dissection.—To denude the great prevertebral centre (solar plexus), the following dissection is to be made :—After the air has been let out of the stomach and the duodenum, the portal vein, the common bile duct, and the gastro-epiploic artery are to be cut through behind the pylorus ; and the stomach, the duodenum, and the pancreas are to be drawn over to the left side. On raising the liver, and taking away some fatty tissue, the vena cava appears : the vein is to be cut across above the junction of the renal vein with it, and the lower end is to be drawn down with hooks.

and the
semilunar
ganglia.

Beneath the vein the dissector will find the large reddish semilunar ganglion of the right side. From its inner part he should trace the numerous nerves which form the solar plexus around the coeliac and superior mesenteric arteries ; and should unravel the offsets around those arteries, with their secondary plexuses. From the outer part of the ganglion branches are to be traced to the kidney, the suprarenal body, and the diaphragmatic arteries. At its upper part the student may observe the large splanchnic nerve ; and deeper than it, one or two other smaller splanchnic nerves, which throw themselves into the solar and renal plexuses. Mixed up with the nerves of the solar plexus are numerous lymphatic glands and a dense tissue, which require to be removed with care.

Follow the
ending of
the vagus
nerves.

The student should then trace the ending of the pneumogastric nerves on the stomach. The left nerve will be found in front near the upper border ; and the right nerve will be seen at a corresponding point on the opposite aspect. Branches are to be traced from the right nerve to the plexus of the sympathetic by the side of the coeliac axis, and from the left to the hepatic plexus.

The EPIGASTRIC or SOLAR PLEXUS is the largest of the prevertebral plexuses of the sympathetic, and furnishes nerves to all the viscera of the abdomen above the pelvis. It is a large network of nerves and ganglia, which lies in front of the aorta and the pillars of the diaphragm, and extends from the suprarenal capsule of one side to that of the other. It surrounds the coeliac axis and the superior mesenteric artery, and extends downwards to the pancreas. The plexus is connected on each side with the large and small splanchnic nerves, and it is joined also by some twigs from the right pneumo-gastric nerve. Large offsets are furnished to the different viscera along the vessels.

Solar plexus;

appearance,

extent;

gives offsets on blood-vessels.

The *semilunar ganglia* of the solar plexus, one on each side, are the largest ganglia in the body. Each is situated at the upper and outer part of the plexus, close to the suprarenal capsule, and on the side of the pillar of the diaphragm. The ganglion on the right side is beneath the vena cava. Irregular in shape, the mass is sometimes oval, and at other times divided into smaller ganglia. From the outer side nerves are directed to the kidney and the suprarenal capsule, and to the inner side the cords of the solar plexus are connected. At the upper end it is joined by the great splanchnic nerve.

Semilunar ganglia;

situation;

form.

Nerves connected with each.

Offsets of the plexus.—The nerves supplied to the viscera are conveyed on branches of the aorta, forming plexuses around them; thus there are coeliac, mesenteric, renal, spermatic, and other plexuses. The diaphragmatic artery has also a separate plexus on it.

Several offsets of the plexus.

Diaphragmatic plexus.—The nerves that form this plexus come from the upper and outer part of the semilunar ganglion. They are placed at first on the phrenic artery, but they soon leave it to enter the substance of the diaphragm. A communication takes place between the phrenic nerve of the cervical plexus and the branches of the sympathetic.

Plexus to the diaphragm

On the under surface of the diaphragm is a small ganglion where the plexus joins the spinal nerve, and from it filaments are supplied to the vena cava and the suprarenal body. The ganglion is absent on the left side.—(Swan.)

has a ganglion on right side.

The *suprarenal nerves* are very large and numerous, in comparison with the mass supplied, and are directed almost horizontally outwards to the suprarenal body, which they enter at the upper part. One of the splanchnic nerves communicates with this plexus.

Suprarenal nerves.

The *renal plexus* is derived from the semilunar ganglion,

Renal plexus

and the outer part of the solar plexus, and it is further joined by one of the two smallest splanchnic nerves. The nerves surround the renal artery, having small ganglia on them, and enter the kidney with the vessels. An offset is given from the renal nerves to the spermatic plexus (p. 531).

The *coeliac plexus* is a direct continuation forwards of the solar plexus around the artery named coeliac axis. It is further joined by the small splanchnic nerve on each side, and by an offset from the right pneumo-gastric nerve. The plexus surrounds the artery, and divides, like the vessel, into three parts—coronary, splenic, and hepatic.

a. The *coronary plexus* accompanies the coronary artery to the upper border of the stomach which it supplies. It communicates with the left vagus nerve, and with the sympathetic on the pyloric artery.

b. The *splenic plexus* surrounds the splenic artery, and is conducted by it to the substance of the spleen. It furnishes offsets, like the artery, to the pancreas, and to the stomach along the left gastro-epiploic artery. This plexus is joined by twigs from the left semilunar ganglion, and by an offset from the right pneumo-gastric nerve.

c. The *hepatic plexus* is continued on the vena portæ, the hepatic artery, and the bile duct to the transverse fissure of the liver, where it enters the liver and ramifies on the vessels. Whilst ascending in the small omentum, the plexus is joined on the left side by offsets from the left vagus and phrenic nerves.—(Swan.) The following secondary plexuses are furnished around the branches of the hepatic artery, which have the same name and distribution as the vessels:—

A *pyloric plexus* accompanies the pyloric artery to the upper border of the stomach.

There are two other plexuses—*gastro-epiploic* (right) and *pancreatico-duodenal*, corresponding with the branches of the artery: the former meets nerves from the splenic plexus, and the latter communicates with the superior mesenteric plexus on the end of the duodenum.

A *cystic plexus* is distributed to the gall bladder with the artery.

The remaining offsets of the solar plexus, viz., superior and inferior mesenteric, aortic, and spermatic, have been already described (p. 530); but the derivation of the superior mesenteric and aortic plexuses from the epigastric centre can be now seen.

Ending of the splanchnic nerves—The large nerve perfo-

rates the crus of the diaphragm, and generally ends altogether in the semilunar ganglion, but it may give filaments to the renal plexus and the suprarenal body. of large splanchnic nerve,

The *small nerve* comes through the same opening in the diaphragm as the preceding, and ends in the coeliac plexus ; but it enters the renal plexus if the smallest splanchnic nerve is absent.

The *smallest nerve*, after piercing the diaphragm, joins the renal plexus. and smallest.

Ending of the vagus nerve.—In the abdomen the pneumogastric nerves end mostly in the stomach.

The *left nerve* divides into branches, which extend over the front and along the small curvature of the stomach ; these join the sympathetic, and give offsets to the hepatic plexus. Ending of left vagus

The *right nerve* is distributed to the posterior surface of the stomach near the upper border ; it communicates with its fellow, and with the coeliac and splenic plexuses. and right.

Dissection.—The viscera are now to be removed from the abdomen in order that the body may be turned for the dissection of the back, and the lower limbs. Prepare for turning the body by removing the viscera.

The stomach and the spleen with the duodenum and the pancreas are to be taken away together by cutting through the oesophagus near the diaphragm, and by dividing the vessels and nerves they receive. The liver is to be removed from the abdomen by cutting across its ligaments, and the vena cava between its posterior border and the diaphragm. At the same time the right kidney is to be taken out with the suprarenal body. And lastly the dissector should separate the left testicle by cutting through the spermatic cord.

Directions.—Supposing the body to be now turned for the dissection of the back, and to lie with the face downwards for the usual time, the dissector may look first to the disposition of the fascia lumborum, which is described in the Dissection of the Back, p. 420. The rest of the time he should occupy in learning the form and structure of the viscera in the following Section. Directions for the dissector.

SECTION IV.

ANATOMY OF THE VISCERA OF THE ABDOMEN.

THE STOMACH.

- Definition.** The stomach is the dilated part of the alimentary tube between the œsophagus and the small intestine, into which the masticated food is received to be changed into chyme.
- Separate and blow up the stomach.** *Dissection.*—To see the form of the stomach this viscus must be blown up moderately, and the surface should be cleaned; but previously let the student detach the spleen and cut through the duodenum near the pylorus.
- Form, direction, size, divisions.** *Form and Divisions.*—The stomach is somewhat conical in form (fig. 84, s), with the base or wider part to the left, and the apex to the right side; and it is directed obliquely across the abdomen. Its size varies much in different bodies, and is sometimes much diminished by a constriction in the centre. When it is moderately distended, it is about twelve inches long and four wide. The stomach presents for examination two ends, two orifices, two surfaces, and two borders or curves.
- Left end and right.** *Extremities.*—The left end or tuberosity (fundus ventriculi) is the largest part of the stomach, and projects about three inches to the left of the opening of the œsophagus. The right or pyloric end, much smaller than the other, is cylindrical, and forms the apex of the cone to which the stomach is likened.
- Cardiac and pyloric openings; last has a valve.** *Openings.*—The left opening (cardiac), which communicates with the œsophagus, is at the highest part of the stomach, and is funnel-shaped towards the cavity of the organ. The right or inferior orifice (pylorus) opens into the duodenum, and is guarded internally by a valve: at the same spot the stomach is slightly constricted externally, where a firm circular ring may be felt.
- Surfaces rounded or flat.** *Surfaces.*—The surfaces are somewhat flattened when the stomach is empty, but rounded when it is distended. The parts in contact with the sides have been referred to (p. 515).
- Upper border; lower border.** *Borders.*—The upper border, or small curve of the stomach, is concave towards the left opening, but convex at the opposite end; and the lower border, or large curve, is convex, except near the right end where it is concave:—

the concavity of the one border corresponds with the convexity of the other. An arterial arch and a fold of peritoneum (omentum) extend along each border.

STRUCTURE.—In the wall of the stomach are four layers or coats, viz. serous, muscular, fibrous, and mucous; together with vessels, nerves, and lymphatics.

Serous coat.—The peritoneum gives a covering to the stomach, and is adherent to the surface except at the margins, where an interval exists corresponding with the attachment of the small and the large omentum. In this space are contained the vessels, nerves, and lymphatics of the stomach. During distension of the stomach the space above mentioned is much diminished.

The *muscular coat* will be laid bare by the removal of the serous covering. It consists of three sets of fibres, viz. longitudinal, circular, and oblique; these lie from without inwards in the order mentioned, and are involuntary or non-striated.

a. The *longitudinal fibres* are derived from the œsophagus; they spread over the surfaces, without entirely covering them, and are continued onwards to the pylorus and the small intestine. The fibres are most marked along the borders, particularly the smaller one; and at the pylorus they are much stronger than in the centre of the stomach.

b. The *circular fibres* form the middle stratum of the muscular coat, and will be best seen by removing the longitudinal fibres near the pylorus. They reach from the left to the right end of the stomach; but at the pylorus they are most numerous and strongest, and form a firm ring around the opening.

c. The *oblique fibres* are continuous with the circular or deep layer of the œsophagus, and form only part of a layer in the gastric wall. On the left of the cardiac orifice they are seen to arch over the great end of the stomach, and they spread out on the anterior and posterior surfaces, gradually disappearing on them.

Fibrous or submucous coat.—By removing the muscular layer over a small spot, the fibrous coat will appear as a white shining stratum. Formed of areolar or connective tissue, this coat gives strength to the stomach, and serves as a bed in which the larger vessels and nerves ramify before their distribution to the mucous coat. If a small opening is made in this membrane, the mucous coat will project through it, supposing the stomach to be distended with air.

The *mucous coat* will come into view on cutting open the

stomach, but the appearances about to be described can be seen only in a recent stomach.

This coat is a thickish layer, smooth and soft to the touch, which is of a pale rose colour in the healthy condition soon after death; but in the empty state of the stomach the membrane is less vascular than during digestion. In infancy the natural redness is greater than in childhood or old age. When the stomach is contracted the membrane is thrown into numerous wavy lines or *rugæ*, which are longitudinal towards the pylorus along the great curve. The thickness of the mucous membrane is greatest near the pylorus; and at that spot it forms a fold, opposite the muscular ring, which assists in closing the opening. If this membrane and its submucous layer are removed from the pyloric part of the stomach, the ring of muscular fibres (sphincter of the pylorus) will be more perfectly seen.

Microscopic structure of the mucous membrane.—With the aid of a lens, the surface of the mucous membrane, when well washed, will be seen to be marked all over by shallow depressions or alveoli (fig. 80), which measure from $\frac{1}{300}$ th to $\frac{1}{100}$ th of an inch across. In the bottom of each depression are the apertures of minute tubes. Generally hexagonal or polygonal in outline, the hollows become larger and more elongated towards the small end of the stomach. Near the pylorus the margins of the alveoli project, and become irregular, so as to resemble rudimentary villi.

By means of a thin section under the microscope, the membrane may be seen to be formed almost altogether of minute vertical tubes which lie side by side, and project into the submucous tissue. Measuring from $\frac{1}{300}$ th to $\frac{1}{100}$ th of an inch across and $\frac{1}{60}$ th to $\frac{1}{30}$ th of an inch in length, the tubes are closed at the deep end; but they open on the surface of the stomach both in the alveoli (fig. 80), and in the interalveolar spaces. For the most part they are straight, but towards the pylorus they become longer and somewhat sacculated at the deep extremity. In their interior they are lined by columnar epithelium, which becomes spheroidal in the lower part of the tube; and filling them is a colourless fluid containing a granular material.

* Alveolar depressions of the mucous membrane of the stomach, magnified 32 diameters, with the minute tubes opening into them (Sprott Boyd).



The texture made up of tubes of small size;

closed at deep end; lined by epithelium; contain fluid.

their size,

shape,

and appearance near pylorus.

feel,

colour,

fold,

thickness;

disposition at pylorus.

On the surface are pits or alveoli;

Over the surface of the mucous membrane small *lentiform* Follicles. *follicles* are scattered, which have a depression in the centre, and correspond with the solitary follicles in the intestine. These are in greatest number near the pyloric end of the stomach, and are most marked in young children.

A columnar *epithelium* covers the surface of the mucous Epithelial covering. membrane, and enters the small tubes, as before mentioned.

A thin *submucous stratum of muscular fibres* on the outer Submucous muscular layer, or deeper surface of the mucous membrane has been described throughout the whole alimentary canal.

Bloodvessels of the stomach.—The different *arteries* of the Arteries, stomach, after supplying the muscular coat, ramify in the submucous tissue, and terminate in the mucous coat. From the anastomoses in the submucous stratum, small offsets are continued on the tubes to the inner surface of the mucous membrane, where they form a network. The *veins* begin in veins, the mucous membrane, receive branches from the muscular coat, and deliver their blood into the portal system.

Lymphatics.—Two layers of lymphatics, superficial and lymphatics, deep, are found in the stomach.

Nerves.—The nerves are derived from the pneumo-gastric and nerves. and sympathetic, as before said, p. 543.

SMALL INTESTINE.

The three parts into which the small intestine is divided, Characters. have the following differences in their characters :—

The *duodenum* measures as much as the breadth of twelve Length and fixedness. fingers, viz. about ten inches, and is more fixed than the rest of the intestinal tube. It is wider than either the Width and thickness. jejunum or the ileum, and its muscular coat is also thicker. Into it the common bile duct and the pancreatic duct pour Ducts entering it. their contents.

The *jejunum* and the *ileum* together are about twenty feet Length. long, and are connected with the mesentery. There is not any perceptible difference between the termination of the Division arbitrary. one and the commencement of the other, but two fifths of the length are assigned to the jejunum, and three fifths to the ileum. Between the ends however a marked difference Differences at the ends. may be observed; for the upper part of the jejunum is thicker and more vascular than the lower part of the ileum, and its width is also greater.

STRUCTURE.—In the small intestine the wall is formed Wall has same strata by the same number of layers as in the stomach, viz. serous,

- as the stomach. muscular, fibrous, and mucous. The different layers are to be examined on pieces taken from the duodenum, from the upper part of the jejunum, from the lower end of the ileum, and from the middle of the small intestine. After the pieces of intestine have been cut off, they are to be distended with air.
- Serous coat The *serous coat* is closely connected with the subjacent muscular layer. To the greater part of the small intestine (jejunum and ileum) it furnishes a covering, except at the like that of the stomach, attached part where the vessels enter : at this spot the peritoneum is reflected off to form the mesentery, and a space exists resembling that at the borders of the stomach. The peritoneum surrounds the duodenum only partly ; this peculiarity has been described at p. 523.
- except in the duodenum. The *muscular coat* is constructed of two sets of fibres, a muscular coat is formed by a superficial or longitudinal, and a deep or circular. The fibres are pale in colour, and are not striated.
- longitudinal a. The *longitudinal fibres* will be seen only by a careful removal of the peritoneum, for they are generally taken away with that membrane. They form a thin layer which is most marked at the free border of the gut.
- and a circular layer. b. The *circular fibres* are much more distinct than the others, and give the chief strength to the muscular coat : they do not appear to form complete rings around the intestine.
- Fibrous coat like that in stomach. The *fibrous coat* has the same position and the same use as the corresponding layer in the stomach.
- Dissect fibrous coat Dissection.—On the removal of a part of the muscular stratum from the jejunum or the ileum, the submucous fibrous layer will come into view.
- Glands of Brunner, In the upper part of the duodenum the student is to seek some small compound glands—those of Brunner, which are imbedded in the submucous tissue. They lie beneath the mucous membrane, and will be seen shining through the fibrous layer, when the muscular coat has been taken away.
- and mucous coat. The pieces of intestine may be opened and washed, to show the mucous coat, but the gut should be cut along the line of attachment of the mesentery, so as to avoid Peyer's glands on the opposite side.
- Thickness, *Mucous coat*.—The lining membrane is thicker and more vascular at the beginning than at the ending of the small folds, intestine. It is marked by numerous prominent folds (*valvulae conniventes*). The surface of the membrane is soft, and is covered with small points (*villi*) like the pile of

velvet. Occupying the substance of the mucous coat are numerous glands; and covering the whole is a columnar epithelium. and villous surface.

The *valvulæ conniventes* (valves of Kerkring) are permanent folds of the mucous membrane, which are arranged circularly along the intestine, and project into the alimentary mass. Crescentic in form, they extend round the intestine for half or two-thirds of its circle, and some end in bifurcated extremities. Larger and smaller folds are met with, sometimes alternating; and the larger are about two inches long, with one-third of an inch in depth towards the centre. Each valve is formed of a doubling of the mucous membrane, which encloses vessels between the layers. Folds or valves; arrangement, length, size and depth; how formed.

The little valves begin in the duodenum, about one or two inches beyond the pylorus, and are continued in regular succession to the middle of the jejunum; but beyond that point they become smaller and more distant from one another, and finally disappear about the middle of the ileum, having previously become irregular and rudimentary. The valvulæ are largest and most regular beyond, and not far from the opening of the bile duct. Extent on the intestine.

The *aperture of the common bile and pancreatic ducts* is a narrow orifice, from three to four inches from the pylorus, and is situate in a small prominence on the mucous membrane at the inner and posterior part of the duodenum. A probe passed into the bile duct will show the oblique or valvular course (half an inch) through the wall of the intestine. Sometimes the pancreatic duct opens by a distinct orifice. Opening of bile duct; where situate. Sometimes double.

Microscopic structure of the mucous membrane.—With the use of the microscope, and with pieces of fresh intestine, the student will be able to make out the nature of the villi, the glandular bodies, and the epithelium. Parts to be learnt in the intestine.

Villi.—When a piece of the lower part of the duodenum, from which the mucus is washed away, is examined in water, the mucous membrane will be found studded over very thickly with small projections, like those on velvet. Existing along the whole of the small intestine, both on the valves and between them (fig. 82), these bodies are irregular in form, some being triangular, others conical or cylindrical with a large end. Their length is from $\frac{1}{10}$ th to $\frac{1}{2}$ th of an inch. They are best marked where the valvulæ conniventes are largest; and in the duodenum their number is estimated at 50 to 90 in a square line, but in the lower end of the ileum at only 40 to 70 over the same surface.—Krause. The villi cover the surface; their shape, and size, and number.

ture is slightly larger than the mouths of the contiguous crypts of Lieberkühn. In the small secretory cells of the gland the epithelium is laminar.

The epithelium is columnar.

Epithelium.—The epithelial lining of the mucous membrane of the small intestine is of the columnar or cylindrical kind. For the villi it forms a very distinct covering of elongated or prismatic pieces. It sinks into the crypts of Lieberkühn, and gives them a lining, as before said.

How to see the areolar tissue.

Dissection.—To demonstrate the areolar tissue between the coats of the intestine, a piece of the bowel turned inside out, is to be inflated forcibly; and to ensure the success of the attempt, a few cuts may be previously made through the peritoneal coat. The air enters the wall of the intestine where the peritoneal covering is wanting, and spreads through the whole gut; but opposite the solitary glands and the patches of Peyer the mucous coat is more closely connected with the neighbouring structures, and the subjacent portion will not be distended with the air. The intestine may be examined when it is dry.

Arteries of the intestine;

Vessels of the intestine.—The branches of arteries ramify in the submucous layer, and end in a network of small twigs in the mucous membrane, which supplies the valves, the villi, and the glands. Opposite Peyer's patches the intestine is most vascular; and the vessels form circles around the follicles, and supply offsets to them. The veins have their usual resemblance to the companion arteries.

veins;

absorbents.

The absorbents consist of a superficial longitudinal set (lymphatics), and of a deep transverse set (lacteals), which end in larger vessels in the mesentery. Beneath the patches of Peyer's glands the lymphatics form distinct plexuses.

Two coats in the bile duct;

Structure of the common bile duct.—The bile duct consists of a strong fibrous coat with a few muscular fibres, and of an internal or mucous coat which is lined by cylindrical epithelium. On the surface of the mucous membrane are the openings of numerous branched mucous glands, which lie in the fibrous coat, and external to it; some of them are aggregated together, and are visible without a lens.

epithelium and glands.

LARGE INTESTINE.

Extent of the gut;

The large intestine is the part of the alimentary canal between the termination of the ileum and the anus. Its division and attachment by peritoneum to the abdominal wall have been described (p. 516).

length;

In length this part of the alimentary canal measures about

five or six feet,—one fifth of the whole extent of the intestinal tube. The diameter of the colon is largest at the commencement in the cæcum, and gradually decreases from that part as far as the rectum, where there is, however, a dilatation near the end.

When compared with the small intestine, the colon is found to be distinguished by the following characters:—it is of greater capacity, being in some parts as large again, and is more fixed in its position. The large intestine is also free from convolutions, except in the left iliac fossa where it forms the sigmoid flexure. Instead of being a smooth cylindrical tube, the colon is sacculated; and it is marked by three longitudinal muscular bands, which alternate with as many rows of dilatations. Attached to the surface at intervals, especially along the transverse colon, are processes of peritoneum containing fat,—the appendices epiploicæ.

Compared with small gut, larger; more fixed; not coiled.

Sacculated with bands.

Appendages.

In the rectum, or the lower part of the large intestine, the surface is smooth, and the longitudinal bands have disappeared.

In the rectum.

Dissection.—For the purpose of examining the large intestine the student should select and blow up the cæcum, with part of the ileum entering it; he should prepare also in a similar way a piece of the transverse colon, and a piece of the sigmoid flexure (about four inches of each). The areolar tissue and the fat are to be removed with care from each, after it has been inflated.

Take pieces of the large intestine.

The CÆCUM, or the head of the colon (*caput cæcum coli*) is the rounded part of the large intestine which projects, in the form of a pouch, below the junction of the ileum with it. It measures about two inches and a half in length, and though gradually narrowing inferiorly, the cæcum is the widest part of the colon,—hence the name *caput coli*. At its inner side it is joined by the small intestine; and still lower there is a small worm-like projection—the vermiform appendix.

Definition of cæcum;

length and width;

receives ileum and appendix.

Appendix vermiformis.—This little convoluted projection is attached to the lower and hinder part of the cæcum, of which it was a prolongation at one period in the growth of the embryo. From three to six inches in length, the appendix is rather larger than a goose-quill, and is connected to the inner part of the cæcum by a fold of peritoneum. It is hollow, and has an aperture of communication with the intestine. In structure it resembles the rest of the colon.

Vermiform appendix: attachment;

dimensions.

It is hollow.

Dissection.—To study the interior of the cæcum, and the valve between it and the small intestine, the specimen now under examination should be dried. After the cæcum has

Dry the cæcum, and open it to

see the
valves.

been dried the following cuts should be made into it :—One oval piece is to be taken from the ileum near its termination ; another from the side of the cæcum, opposite the entrance of the small intestine ; and lastly the end of the colon included in the ligature is to be cut off.

Situation of
the valve ;

Ileo-cæcal valve.—On looking into the intestine, the ileo-cæcal valve will be seen at the entrance of the ileum into the cæcum. It is composed of two pieces, each with a different inclination, which project into the interior of the cæcum, and bound a narrow, nearly transverse aperture of communication between the two differently-sized portions of the alimentary canal.

two pieces
in it.

One ileo-
colic ;
the other
ileo-cæcal.

The upper piece of the valve, *ileo-colic*, projects horizontally into the large intestine, opposite the junction of the ileum with the colon. And the lower piece, *ileo-cæcal*, which is the larger of the two, has a vertical direction between the ileum and the cæcum. At each extremity of the opening the pieces of the valve are blended together, and the resulting folds extend transversely for some distance on the intestine, forming the *fræna* or *retinacula* of the valve.

These are
joined at
the ends,
and form
fræna.

Opening in
the valve.

The size of the opening between the pieces of the valve depends upon the distension of the intestine ; for when the extremities or retinacula of the valve are stretched the margins of the opening are approximated, and may be made to touch.

The valve a
prolongation
of the wall
of the gut.

Each piece of the valve is formed by the circular muscular fibres of the intestinal tube, covered by mucous membrane ; as if the ileum was thrust obliquely through the wall of the cæcum, after being deprived of its peritoneal coat and its layer of longitudinal fibres. The construction above referred to is easily seen, on a fresh specimen, by dividing the peritoneum and the longitudinal fibres, and gently drawing out the ileum from the cæcum.

Appendix
opens into
cæcum.

The *opening of the appendix* into the cæcum is placed below that of the ileum. A small fold of mucous membrane closes partly the aperture, and acts as a valve.

Ridges in
the cæcum ;

Folds or ridges are directed transversely in the interior of the gut, and correspond with depressions on the outer surface. These folds result from the doubling of the wall of the intestine, and the largest enclose vessels.

how
formed.

Four strata
in the wall
of the gut.

STRUCTURE OF THE COLON.—The coats of the large intestine are similar to those in the small gut, viz. serous, muscular, fibrous, and mucous.

Serous coat
differs along
the intes-
tine.

Serous coat.—The peritoneum does not invest the large intestine throughout in the same degree. It covers the

front of the cæcum, and the front and sides of the ascending and descending colon; but in neither does it reach commonly the posterior aspect (p. 523). The transverse colon is incased like the stomach, and has an interval along each of the borders where the transverse meso-colon and the great omentum are attached.

The *muscular coat* is formed by longitudinal and circular fibres, as in the small intestine, but the former are arranged in bands. Two layers of fibres;

a. The *longitudinal* set of fibres may be traced in the cæcum as a thin layer over all the surface, but they are collected for the most part into three longitudinal bands, each being about half an inch in width. On the vermiform appendix the longitudinal fibres form a uniform layer. They are continued thence in the form of bands along the cæcum and colon. On the rectum they are diffused over the surface as on the cæcum. When the bands are divided the intestine elongates—the sacculi, and the ridges in the interior of the gut disappearing at the same time. longitudinal in three bands; which are spread out on appendix and rectum;

b. The *circular fibres* are spread over the whole surface, but are most marked in the folds or ridges that project into the intestine. In the rectum (to be afterwards seen) they form the band of the internal sphincter muscle. and circular.

The *fibrous coat* resembles that of the small intestine. It will be exposed by removing the peritoneal and muscular coverings. Fibrous coat as in small gut.

The *mucous coat*, which will be seen on opening the intestine, is smooth, and of a pale yellow colour. It is not thrown into special folds, except in the rectum. The surface is free from villi; and by this circumstance the mucous membrane of the large can be distinguished from that of the small intestine. This surface difference in the two portions of the tube is well seen in the ileo-cæcal valve; for the surface which looks to the small intestine is studded with villi, whilst the lower surface which is covered by the lining membrane of the cæcum is free from those eminences. Mucous coat is without folds and villi.

Microscopic appearances.—In a piece of fresh intestine the mucous membrane may be seen with the microscope to possess small tubes or crypts, some larger solitary follicles, and an epithelial covering. Structure like that of small gut.

The *tubules* or crypts (Fig. 83, C) occupy the whole length of the large gut, and resemble those of the small intestine, but are more numerous and closer together. Their orifices on the surface are circular (1), and are more uniformly diffused than the apertures of the crypts in the small gut. Tubes or crypts more numerous and longer than

those of
small
intestine.

Simple
glands
most in the
cæcum;
size

and form.

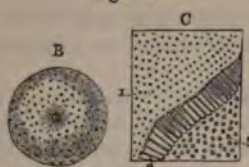
Epithelium.

Vessels and

absorbents.

vertical section of the membrane (2) will show the tubes to extend vertically from the surface into the submucous coat, and to be of greater length than the crypts of Lieberkühn in the jejunum and ileum; they measure from $\frac{1}{50}$ th to $\frac{1}{40}$ th of an inch in length, and $\frac{1}{200}$ th to $\frac{1}{150}$ th of an inch across.

Fig. 83.*



The *solitary follicles* (Fig. 83, B) are found all through the large intestine, scattered here and there; but they are in greatest number in the cæcum and vermiform appendix. They are whitish rounded bodies from $\frac{1}{20}$ th to

$\frac{1}{10}$ th of an inch in diameter, and are situate in the submucous layer amongst the tubules. These follicular glands are simple sacs without opening, as in the small intestine, but over each is a depression in the mucous membrane simulating an aperture into it (Kölliker).

The *epithelium* is of the columnar kind, as it is in the small intestine, and enters the tubules.

Vessels.—The distribution of the vessels in the wall of the large intestine is the same as in the smaller bowel.

The *absorbent vessels*, after leaving the intestine, join the lymphatic glands along the side of the colon.

THE PANCREAS.

Form and
length;
divisions.

Situation
and form.

The head
and tail;
and the
body.

Trace out
the duct.

The pancreas (Fig. 84) is a narrow flattened gland from six to eight inches in length, which has some resemblance to a dog's tongue. It is larger at the right than at the left end; and it is divided into a head, tail, and body.

The *head*, or the right extremity (h), occupies the concavity of the duodenum; whilst the left extremity, or the *tail* (t), is rounded, and touches the spleen.

The *body* of the gland (v) is narrowest a little to the right of the vertebral column, and is thickest at the upper border; it measures about one inch and a half in breadth, and from half an inch to an inch in thickness. The connections of the pancreas with surrounding parts are described at p. 534.

Dissection.—Let the pancreas be placed on the anterior

* Enlarged view of a solitary gland and the tubules of the mucous coat (Boehm). B. A section of a follicle. C. Tubules of the mucous membrane. 1. Surface opening. 2. Side view of the tubes. 3. Pits for the closed ends of the tubes in the submucous tissue.

surface, and the excretory duct contained in its substance be traced posteriorly from right to left. The duct will be recognised by its white colour.

STRUCTURE.—The pancreas is a compound gland, and is provided with a special duct. It is destitute of a distinct capsule; but it is surrounded by areolar tissue, which pro-

It is a compound gland, without a distinct capsule.

Fig. 84.*



jects into the interior, and connects together the lobules. The fluid secreted by it assists in the digestion of the aliment.

The glandular structure is soft and loose in texture, and is of a reddish, or grayish white colour. It consists of lobules, which are united into larger masses by areolar tissue, vessels, and ducts. In analysing a lobule it will be found to consist ultimately, as in the parotid, of the branchings of the excretory duct, which end in closed vesicular extremities, and are surrounded by a plexus of vessels. In the cells the epithelium is flattened.

The duct of the pancreas (canal of Wirsung) extends the entire length of the gland, and is somewhat nearer the lower than the upper border. It begins in the tail of the pancreas, where it presents a bifurcated extremity; as it continues

constitution like the salivary glands.

The duct of the gland; extent;

* This cut shows the liver and gall bladder, the stomach raised, and the duodenum, pancreas, and spleen (Tiedemann). *l.* Liver. *g.* Gall bladder, and *f.* Common bile duct. *s.* Stomach. *o.* Oesophagus joining it, and *p.* Pyloric, and *d.* Duodenum. *i.* Pancreas. *h.* The head, and *t.* The tail of the same, with *e.* The pancreatic duct. *r.* The spleen. *a.* Aorta. *n.* Superior mesenteric artery.

branches;	onwards to the head of the gland, it receives many branches, and it finally ends by opening into the duodenum, either in union with, or separate from the common bile duct (p. 539).
termination.	Of the tributary branches the largest is derived from the head of the pancreas.
Size and structure.	The duct measures from $\frac{1}{15}$ th to $\frac{1}{10}$ th of an inch in diameter near the duodenum. It is formed of a <i>fibrous</i> and a <i>mucous</i> coat : the latter is lined by a cylindrical <i>epithelium</i> , and is provided with small branched glands in the duct and its largest branches.
Epithelium and glands.	
Peculiarities ;	Occasionally there are two pancreatic ducts. Or the branch from the head of the pancreas may open separately into the duodenum, one inch or more from the chief duct.
Vessels and nerves.	<i>Vessels, lymphatics and nerves.</i> —The arteries and veins have been described already ; and the lymphatics join the lumbar glands. The nerves are furnished by the solar plexus.

THE SPLEEN.

Consistence and colour of the spleen.	The spleen is a vascular spongy organ of a bluish or purple colour, sometimes approaching to gray. It has but slight consistence, so that the texture is friable and easily broken under pressure. The use of the spleen is unknown.
Use.	
Form and position.	The viscus is somewhat elliptical in shape, and is placed vertically against the great end of the stomach, as before described (p. 518).
Surfaces.	At the outer aspect it is convex towards the ribs. The inner surface is marked by a longitudinal ridge nearer the posterior than the anterior border, into which the vessels plunge to ramify in the interior. Before and behind the ridge, the surface is flattened or somewhat hollowed. The spot where the vessels enter is named the hilus of the spleen.
Borders. Extremities.	The anterior border is thinner than the posterior, and is often notched. Of the two extremities, the lower is more pointed than the upper.
Size	The size of the spleen varies much. In the adult it measures commonly about five inches in length, three or four inches in breadth, and one or one inch and a half in thickness. Its weight lies between four and ten ounces, and is rather less in the female than in the male.
and weight.	
Sometimes accessory spleens.	Small masses or <i>accessory spleens</i> (splenuli) are found occasionally near the fissure of the spleen in the gastro-splenic omentum, or in the great omentum. Varying in size from a bean to a moderate sized plum, these bodies are commonly one or two in number ; but they

may be many more. In one instance they exceeded even a score.

STRUCTURE.—Enveloping the spleen are two coverings, a serous and a fibrous. The mass of the spleen is formed by a network of fibrous or trabecular tissue, which contains in its meshes the proper splenic substance, with the Malpighian corpuscles. Throughout the mass the blood-vessels and the nerves ramify. No duct exists in connection with this organ.

Two coats and special material in the spleen.

The *serous* or *peritoneal coat* incases the spleen, and covers the surface except at the hilus and the posterior border. It is closely connected to the subjacent fibrous coat.

Serous coat nearly complete.

The *fibrous coat* (*tunica albuginea*) gives strength to the spleen, and forms a complete case for it. At the fissure on the inner surface this investment passes into the interior with the vessels, to which it furnishes sheaths; and if an attempt is made to detach this coat, numerous fibrous processes will be seen to be connected with the inner surface. Its colour is whitish; and its structure is made up of areolar and elastic tissues. In certain animals muscular fibres are said to be present in it.

Fibrous coat sends inwards processes.

Fibres that form it.

Dissection.—The spongy or trabecular structure will come into view, by washing and squeezing a piece of fresh (bullock's) spleen under water, so as to remove the grumous looking material.

Interior of spleen,

The *trabecular tissue* forms a network through the whole interior of the spleen, similar to that of a sponge, which is joined on the one hand to the external casing and on the other to sheaths around the vessels. Its processes or threads are white, flattened or cylindrical, and average from $\frac{1}{100}$ th to $\frac{1}{30}$ th of an inch: they consist of fibrous and elastic tissues. In animals muscular fibres are described as existing in the processes (Kölliker). The interstices between the fibres communicate freely together, and contain the proper substance of the spleen, and the vessels.

and disposition of fibrous tissue in it.

To form an areolar structure.

Microscopic appearances.—The characters of the substance of the spleen and of the Malpighian bodies must be made out with the aid of the microscope.

The *splenic pulp* is a soft semi-fluid red-brown mass, which fills the areolæ of the white trabecular structure. Under the microscope this material is composed of very fine fibres and bloodvessels, with special cells, and small masses of blood undergoing transformation into pigment granule cells (Kölliker).

Splenic substance: colour, and composition.

- Cells of spleen-pulp. The special cells are united by a reddish-yellow fluid, and form the half of the pulpy substance : they are of different sizes, apparently as if in different stages of growth, the smallest being nucleus-like bodies, and the largest are pale one or two nucleated, and granular cells.
- Malpighian bodies ; size ; attachment ; The *Malpighian corpuscles* are best seen in the human body after sudden death, or in children. They are small vesicular bodies, averaging $\frac{1}{80}$ th of an inch in diameter, and are appended, mostly without pedicles, to the sheaths of the smallest branches of the arteries ; they project into the pulp of the spleen, and are surrounded by it except at the attached side. Each is a closed sac, having a membranous case with contents.
- constituents. The coat of the corpuscle is transparent, and is said to consist of the same tissue as the sheaths of the small arteries, with the exception of muscular fibre (Kölliker). In the interior is a tenacious whitish albuminous mass, with different sized pale cells, granular as well as nucleated, of the same nature as those in the spleen-pulp.
- Splenic artery supplies corpuscles of spleen. *Bloodvessels.*—The *branches of the splenic artery* are surrounded by sheaths of fibrous tissue, even to the terminal twigs. The chief branches are said not to join together ; and they accompany the veins till they have a diameter of $\frac{1}{100}$ th to $\frac{1}{20}$ th of an inch. They then leave the veins, and, still surrounded by sheaths, end in the smallest branches. The terminal branches of the artery pass by the Malpighian bodies in the splenic pulp, supplying fine twigs to them which ramify in their interior, and end by means of tufts of offsets in the capillaries.
- End in capillaries. The *splenic vein* begins in a meshwork of capillaries in the splenic pulp of the intertrabecular spaces, and without dilatations (Kölliker). The branches of veins are much larger than the arteries which they accompany to the fissure of the spleen ; and in their course they receive accessory branches, some joining at a right angle.
- Vein begins by capillaries. The *splenic vein* begins in a meshwork of capillaries in the splenic pulp of the intertrabecular spaces, and without dilatations (Kölliker). The branches of veins are much larger than the arteries which they accompany to the fissure of the spleen ; and in their course they receive accessory branches, some joining at a right angle.
- Lymphatics. *Nerves and lymphatics.*—The *lymphatics* are superficial and deep, and enter the glands in the gastro-splenic omentum ; their arrangement in the spleen is unknown.
- Nerves. The *nerves* come from the solar plexus, and surround the artery and its branches ; according to Ecker they end in free dichotomous points by the sides of the arterial tufts.

THE LIVER.

- Office of the liver. The liver secretes the bile, and is the largest gland in the

body. Its duct opens into the duodenum with that of the pancreas.

Dissection.—Preparatory to examining the liver, the vessels at the under surface should be dissected out. This proceeding will be facilitated by distending the vena cava and vena portæ with tow or cotton wool, and the gall-bladder with air through its duct. The several vessels and ducts are then to be defined, and the gall-bladder to be cleaned. On following outwards the left branch of the vena portæ to the longitudinal or antero-posterior fissure, it will be found connected anteriorly with the remains of the umbilical vein, and posteriorly with the remains of the ductus venosus.

The liver is of a red-brown colour and firm consistence; and weighs commonly in the adult from three to four pounds (fifty to sixty ounces). Transversely the gland measures from ten to twelve inches; from front to back between six and seven inches; and in thickness, at the right end, about three inches, but this last measurement must vary with the spot examined.

In shape the liver is somewhat square. It offers for examination two surfaces, two borders, and two extremities; and the under surface is further marked by lobes and fossæ, and by fissures which contain vessels.

The connections and the ligaments of the liver are described at pp. 517, and 524.

Surfaces.—On the upper aspect the liver is convex; extending from front to back is the suspensory ligament, which divides the upper surface into two unequal parts, of which the right is the larger. The under surface is irregular, and presents, as before said, lobes, fissures, and fossæ. In contact with this surface is the gall-bladder; and a longitudinal fissure divides it into a right and left lobe.

Borders.—The anterior border is thin, and is marked by two notches: one is opposite the fissure on the under surface before alluded to, and the other is over the large end of the gall-bladder. The posterior border is much thicker at the right than at the left end, and at the thickened part it touches the right kidney and the diaphragm. Opposite the vertebral column is a hollow in this border; and the vena cava is partly imbedded in the liver on the right of the spine.

Extremities.—The right extremity of the liver is thick and rounded, and the left is thin and flattened.

Lobes.—On the under surface the liver is divided pri-

- on under surface, and are five, viz. marily into two lobes, a right and a left, by the antero-posterior or longitudinal fissure; and on the under surface of the right lobe are three others, viz. the square, the Spigelian, and the caudate lobe.
- left, The left lobe is smaller and thinner than the right, and has a slight depression inferiorly where it touches the stomach.
- right; The right lobe forms the greater part of the liver, and is separated from the left by the longitudinal fissure on the one surface, and by the suspensory ligament on the other. To it the gall-bladder is attached; and the following lobes are projections on its under surface.
- last sub-divided into
- square, The square lobe (*lobulus quadratus*) is situate between the gall-bladder and the longitudinal fissure. It reaches anteriorly to the margin of the liver, and posteriorly to the fissure (transverse) by which the vessels enter the interior of the viscus.
- Spigelian, The Spigelian lobe lies behind the transverse fissure, and forms a roundish projection on the surface. On its left side is the longitudinal fissure, and on its right, the vena cava inferior.
- and caudate lobe. The caudate lobe is a slight elongated eminence, which is directed from the Spigelian lobe behind the transverse fissure, so as to form the posterior boundary of that sulcus. Where the fissure terminates this projection subsides in the right lobe.
- Three fissures, viz. *Fissures*.—Extending horizontally half across the right part of the liver, between the Spigelian and caudate lobes on the one hand, and the square lobe on the other, is the transverse or portal fissure. It is nearer the posterior than the anterior border, and contains the vessels, nerves, ducts, and lymphatics of the liver. At the left end it is united at a right angle with the longitudinal fissure.
- portal or transverse,
- longitudinal; The longitudinal fissure extends from the front to the back of the liver between the right and left lobes. In the part anterior to the transverse fissure (fissure for the umbilical vein) is the remnant of the umbilical vein, which is called round ligament, and is oftentimes arched over by a piece of the hepatic substance (*pons hepatis*). In the part behind the transverse fissure (fissure for the ductus venosus) is a small obliterated cord that remains from the vessel named ductus venosus in the fetus.
- one for the vena cava. The fissure or groove for the vena cava is placed on the right side of the Spigelian lobe, and is frequently bridged

over by the liver. If the cava be opened large hepatic veins will be seen entering it.

Fossæ.—On the under surface of the right lobe are three depressions:—one for the gall-bladder to the right of the square lobe; another for the colon, near the anterior part; and a third for the kidney near the posterior part. Fossæ
beneath.

Vessels of the transverse fissure.—The vessels in the transverse fissure, viz. vena portæ, hepatic artery, and duct, have the following position:—the duct is anterior, the portal vein posterior, and the artery between the other two. Vessels
in the
transverse
fissure.

Hepatic duct (fig. 84).—The hepatic duct is formed by two branches from the liver, one from each lobe, which soon blend in a common tube. After a distance of one inch and a half it is joined by the duct of the gall-bladder; and the union of the two gives rise to the common bile duct (*f*). Hepatic
duct.

The *hepatic artery* is divided into two, one for each lobe, and its branches are surrounded by nerves and lymphatics. Hepatic
artery.

The *vena portæ* branches, like the artery, into two trunks for the right and left lobes, and gives an offset to the Spigelian lobe: its left branch is the longest. Vena portæ.

Fetal condition of the umbilical vein.—In the longitudinal fissure are the remains of a vessel which has the undermentioned arrangement in the fetus. Before birth the large *umbilical vein* occupies the longitudinal fissure, and opens posteriorly into the vena cava. Purified or placental blood circulates through the vessel at that period; and the part of the vein behind the transverse fissure receives the name *ductus venosus*. Branches are supplied from the vein to both lobes of the liver; and a large one, which is directed to the right lobe, is continuous with the left division of the vena portæ. Umbilical
vein in the
longitudinal
fissure in
the fetus,

After birth the part of the umbilical vein in front of the transverse fissure is closed, and becomes eventually the round ligament. The part behind the transverse fissure, or the ductus venosus, is also obliterated, only a thin cord remaining in its place (the obliterated ductus venosus). Whilst the lateral branches, which are in the same line as, and continuous with the left branch of the vena portæ, remain open, and subsequently form part of the portal system of vessels. Occasionally the ductus venosus is found more or less pervious. condition
after birth.

Glandular structure is incased by two coats.

STRUCTURE OF THE LIVER.—The substance of the liver consists of a collection of small secreting bodies, called lobules or acini ; together with vessels, which are concerned both in the production of the secretion and in the nutrition of the organ. The whole is surrounded by a fibrous and a serous coat.

Serous coat, where deficient.

1. *Serous coat.*—The peritoneum invests the liver almost completely, and adheres closely to the subjacent coat. At certain spots intervals exist between the two, viz. in the fissures occupied by vessels, at the lines of attachment of the ligaments, and at the surface covered by the gall-bladder. Where the right lateral ligament is inserted the space is the largest.

Fibrous covering is prolonged to the interior.

2. The *fibrous covering* is very thin, but it is rather stronger where the peritoneum is not in contact with it. It invests the liver, and is continuous at the transverse fissure with the fibrous sheath (capsule of Glisson) surrounding the vessels in the interior. When the membrane is torn from the surface, it is found to be connected with fine shreds that dip between the lobules or glandular structure of the liver.

Lobules of the liver ;

size and appearance ; form and investment.

Size and form of the lobules.—The lobules (fig. 86, 1) constitute the proper secretory substance, and can be seen either on the exterior of the liver, or on a cut surface, or by means of a rent in the mass. As thus observed, these bodies are about the size of a pin's head, and measure from $\frac{1}{20}$ th to $\frac{1}{10}$ th of an inch in diameter. Closely massed together, each presents a dark central point, and is isolated from the surrounding ones by a stratum of areolar tissue. By means of transverse and vertical sections of the lobules, their form will appear triangular on the exterior, but five or many sided in the interior of the liver. They are clustered around the smallest divisions (sublobular) of the hepatic vein, to which each is connected by a small twig issuing from the centre (intralobular vein), something like the attachment of the lamina to the stalk or petiole of a leaf. The part of each lobule in contact with the small sublobular vein wants the covering of areolar tissue that invests the other sides.

To study the minute structure of the lobules the student should have the different vessels of the liver minutely injected, and should be provided with a microscope.

A lobule is a distinct gland.

Constituents of the lobules.—Each lobule or elementary piece of the liver is composed of minute hepatic secretory cells, which are arranged in lines so as to leave intervals

between them ; and it is provided also with a capillary network of vessels, and with radicles of an excretory duct.

Cells of the lobules.—The hepatic or *biliary* cells (fig. 85) are irregular in form, being rounded or flattened, elongated or many sided, and possess a bright nucleated nucleus, or even more than one. In size they vary from $\frac{1}{1080}$ th to $\frac{1}{340}$ th of an inch. They are of a yellowish colour, and enclose a half fluid substance, probably the elements of the bile, together with fatty and yellow colouring particles. These nucleated cells adhere together by their surfaces so as to form rows, with spaces between them, which radiate from the centre to the circumference of the lobule ; and this linear arrangement is oftentimes less regular at the outer third of the lobule. The cells are concerned in the secretion of the bile.

Fig. 85.*



Biliary cells of the lobule.
Situation and form ;
size and contents ;

connection with ducts.

Vessels of the lobule.—The disposition of the several vessels is the following :—The smallest branches of the *vena portæ*, after uniting in a circle around the lobule where they are named interlobular, enter its substance, and form therein a network of capillaries near the circumference. A small branch of the *hepatic vein* occupies the centre of the lobule, and its radicles communicate with the portal plexus ; it issues from the base of the lobule as the intralobular vein. The *radicles* of the *bile duct* are supposed to communicate with the intercellular spaces in the lobule (Beale) : they leave the lobules at the circumference, and are joined together but sparingly outside them.

Arrangement of its vessels, viz. *vena portæ*,

hepatic vein,

and bile duct.

From the facts above stated respecting the arrangement of the vessels, it would appear that the portal vein conducts the blood from which bile is secreted ; that the hepatic vein carries away the superfluous blood ; and that the secreted bile is received by the branches of the biliary duct.

Use of the vessels.

VESSELS OF THE LIVER.—Two sets of vessels ramify in the liver :—One set concerned in the secretion and the nutrition of the organ, enters the transverse fissure, and is directed transversely in spaces named portal canals, where it is enveloped by areolar tissue. The other set consisting of the hepatic veins is without a sheath, and runs from the anterior to the posterior border of the liver. The ramifications of these different vessels are to be traced in the liver.

Arrangement of vessels in the liver.

* Hepatic cells of the lobules of the human liver (Baly).

Capsule of
Glisson, with
vessels in
transverse
fissure:

extends to
the lobules.

Vena portæ

occupies
portal
canals,

and supplies
vaginal

and inter-
lobular
branches.

Hepatic
artery
nourishes
the liver,
and joins
vena portæ.

Hepatic
veins with-
out a
sheath

The *capsule of Glisson* is a layer of areolar tissue, which envelops the vessels entering the liver through the transverse fissure. In this sheath the vessels ramify, and in it they are minutely divided before their termination in the lobules. Processes of the sheath accompany the small interlobular vessels, and join the covering of the lobules. If a transverse section is made of a portal canal, the vessels will retract somewhat into the loose surrounding tissue.

The *vena portæ* ramifies in the liver like an artery; and the blood circulates through it in the same manner, viz., from trunk to branches. After entering the transverse

fissure the vein divides into large branches; these lie in the portal canals or spaces with offsets of the hepatic artery, the hepatic duct, and the nerves and lymphatics (fig. 86, P). The division is repeated again and again; and the resulting vessels give off minute lateral branches (*vaginal*) (*p*), which ramify in the loose capsular sheath. Finally, the last branches of the vein (*interlobular*, *i*, *i*) penetrate between the lobules, around which they

form a circle, and end in the interior as before explained.

The *hepatic artery* is consumed in the nutrition of the structure of the liver. Whilst surrounded by the capsule of Glisson (fig. 86, *a*), it furnishes *vaginal* branches which ramify in the sheath and give it a red appearance in a well injected liver; it supplies other twigs to the coats of the vena portæ and the biliary duct. From the vaginal branches a few offsets are sent to the lobules to supply their structure. This artery is supposed to terminate in capillaries that communicate with the branches of the vena portæ.

The *hepatic vein* (*venæ cavæ hepaticæ*) begins by a plexus in the interior of each lobule, and its smallest radicle issues from the base of the lobule as the *intra-lobular vein*. By the

Fig. 86.*



* Vessels in a portal canal and the lobules of the liver (Kiernan).—*l, l*. Lobules of the liver. *P*. Branch of the vena portæ, with *p p*, vaginal branches which supply interlobular offsets, *i, i*. *a*. Hepatic artery. *d*. Hepatic duct. *i, i, i*. Openings of interlobular branches of the portal vein.

union of the intralobular roots still larger or *sublobular* branches are produced. The next sized branches formed by the sublobular twigs, and ceasing to receive any intralobular veins, merely unite with neighbouring branches to produce larger trunks. Finally, the hepatic veins are directed from before backwards to the vena cava inferior, into which they open by large orifices. The *venæ cavæ hepaticæ* may be said to be without a sheath, for this is very slight only in the larger trunks: so that when they are cut across the ends remain patent in consequence of their close connection with the hepatic structure.

Hepatic duct (fig. 86, *d*).—The duct commences within the lobules by radicles corresponding with the spaces between the rows of cells. On leaving the lobules the ducts communicate here and there between them; and the small ducts soon unite into larger *vaginal* branches, which lie in the portal canals with the other vessels. Lastly, the ducts are collected into a right and a left trunk, and leave the liver at the transverse fissure as before described.

Some ducts exist between the pieces of the peritoneum in the left lateral ligament of the liver, and in a few other spots; they anastomose together, and are accompanied by branches of the vessels of the liver, viz., vena portæ, hepatic artery, and hepatic vein.

Structure.—The larger hepatic ducts consist of a fibrous coat lined by a mucous layer with cylindrical epithelium and branched glands; and some of the glands are arranged in a row on each side. In the smallest ducts the epithelium becomes flattened.

THE GALL BLADDER.

The gall-bladder (fig. 84, *g*) is the receptacle of the bile. It is situate in a depression on the under surface of the right lobe of the liver, and to the right of the square lobe. Conical in form, or pear-shaped, its larger end (*fundus*) is directed forwards beyond the margin of the liver; whilst the smaller end, or the neck, is turned in the opposite direction, and bends downwards to end in the cystic duct by a zigzag part. In length the gall-bladder measures three or four inches, and in breadth rather more than an inch at the fundus or the widest part. It holds rather more than an ounce. By one surface the sac is in contact with the liver, and on the opposite it is covered by peritoneum. The larger end touches the abdominal wall

- opposite the tip of the cartilage of the tenth rib, where it is contiguous to the transverse colon ; and the small end is in contact with the duodenum.
- Structure of wall.** *Structure.*—The wall of the gall-bladder has a peritoneal, a fibrous and muscular, and a mucous coat, with thin intervening layers of areolar tissue.
- Serous coat.** The *serous coat* is stretched over the under or free surface of the gall-bladder, and surrounds the large end.
- Fibrous and muscular stratum.** The *muscular coat* is very thin, and gives a covering to the sac ; it has much areolar tissue intermixed with the fibres.
- Mucous layer is areolar on surface,** The *mucous coat* is marked internally by numerous ridges and intervening depressions, which give an areolar or honey-comb appearance to the surface. On laying open the gall-bladder this condition will be seen, with the aid of a lens, to be most developed about the centre of the sac, and to diminish towards each extremity. The surface of the mucous membrane is covered by a columnar epithelium.
- and covered by a columnar epithelium.**
- Projections of the wall.** Where the gall-bladder ends in the cystic duct its coats project into the interior, and give rise to ridges that resemble the parietal prominences in the sacculated large intestine.
- Duct of gall-bladder.** The *cystic duct* joins the hepatic duct at an acute angle, to form the ductus communis choledochus. It is about an inch and a half long, and is distended and somewhat sacculated near the gall-bladder.
- Structure same as sac,** *Structure.*—The coats of the duct are formed like those of the sac from which it leads, but the muscular fibres are very few. The mucous lining is provided with branched glands, as in the hepatic and common bile ducts (p. 552).
- and is provided with glands.**
- Mucous coat like a screw.** *Valve of the gall-bladder.*—On slitting open the duct the mucous membrane is seen to form a series of semilunar projections (from nine to twenty), which are arranged obliquely around the tube, like the thread of a screw, and increase in size towards the gall-bladder. This structure is best seen on a gall-bladder that has been inflated and dried ; as in this state the parts of the duct between the folds are most stretched.
- Artery and vein,** *Bloodvessels and nerves.*—The vessels of the gall-bladder are named *cystic*. The artery is a branch of the hepatic ; and the cystic vein opens into the vena portæ near the liver.
- nerves and lymphatics.** The *nerves* are derived from the hepatic plexus, and entwine around the vessels. The *lymphatics* follow the cystic duct, and join the deep lymphatics on the spinal column.

THE KIDNEY AND THE URETER.

The kidney has a characteristic form :—flattened on the sides, it is larger at the upper than at the lower extremity, and is hollowed out at one part of its circumference. For the purpose of distinguishing between the right and left kidneys, let the excavated margin be supposed to be turned to the spinal column, whilst the ureter or the excretory tube is kept behind the other vessels ; and let that end be directed downwards, towards which the ureter is naturally inclined.

With the special form above mentioned, the kidney is of a deep red colour, and presents an even surface. Its length is about four inches, its breadth two, and its thickness about one inch ; but the left is commonly longer and more slender than the right kidney. Its usual weight is about five ounces and a half in the male, and rather less in the female.

The upper extremity of the kidney is rounded, is thicker than the lower, and is surmounted by the suprarenal body. The lower end is flat and more pointed. The position with respect to the spinal column has been before detailed (p. 518). On the anterior surface the kidney is rounded, but on the opposite surface it is flattened. The outer border is convex ; but the inner is excavated, and is marked by a longitudinal fissure,—*hilum*. Opposite the excavation is a hollow in the interior of the kidney named *sinus*, into which the hilum leads, and in which the vessels and the duct are contained before they pierce the renal substance.

In the fissure of the kidney the several vessels are thus placed with respect to one another :—The divisions of the renal vein are in front, the ureter is behind, and the branches of the artery lie between the other two. On the vessels the nerves and lymphatics ramify, and areolar tissue and fat surround the whole.

Dissection.—To see the interior it will be necessary to cut through the kidney from the inner to the outer border, and to remove the loose tissue from the vessels, and the divisions of the excretory duct. The hollow or sinus containing the bloodvessels now comes into view.

The *interior of the kidney* appears on a section to consist of two different materials, viz., of an external granular or cortical part ; and of internal, darker coloured, pyramidal masses, which converge towards the centre, and are connected with the divisions of the excretory duct. But it will subsequently appear that these parts are constructed of the same elements, though with a different arrangement.

The *cortical substance*, or the external part, forms about

Use and form.

To distinguish right from left.

Colour.

size.

and weight.

Extremities ;

surfaces ; borders.

Contents of the fissure ; their position.

Open the kidney, and clean vessels.

Renal substance divided into cortical and pyramidal.

Extent of

cortical substance; three-fourths of the kidney ; it covers the pyramidal masses with a layer about two lines in thickness, and sends prolongations between the same nearly to their apices. Its colour; is of a light red, unless the kidney is blanched ; and consistence; its consistence is so slight that the mass gives way beneath the finger. This layer is formed of a congeries of convoluted uriniferous tubes, surrounded by vascular plexuses ; and in a composition. well-injected specimen, red points (Malpighian bodies) are scattered here and there through its texture.

Pyramids; The *pyramidal masses* (pyramids of Malpighi, medullary number, substance,) are twelve or eighteen in number, and converge form, and to the sinus of the kidney. Each mass is conical in form. direction, The base, turned towards the circumference of the organ, is surrounded by the cortical substance ; and the apex, which is free from cortical covering, is directed to the hollow at the inner part of the kidney. Internally the pyramidal mass ends in a smooth, rounded part, named *mamilla* or *papilla*, and is surrounded by one of the divisions (calyx) of the excretory tube. Occasionally two of the masses are end in united in one papillary termination. Each conically-shaped papillae. mass is constructed of uriniferous tubes, like the cortical covering ;—but in it the tubes have become straight, and are converging to their termination on the papilla. The cut surface has a grooved appearance indicative of its construction ; and if the mass is compressed, urine will exude from the tubes, through apertures in the apex.

Rudiment- In the human fetus, and in some animals, the kidney ary condition of the kidney. is divided into separate lobes ; and each lobe consists of a pyramidal mass with a cortical envelope. With the growth of the human kidney the original divisions disappear, and the cortical covering of contiguous lobes is blended to produce the interlobular cortical part. But the uriniferous tubes and the vessels of each pyramid and its cortical substance, which correspond with one of the primary lobes, remain distinct in the adult.

Secretory tubes are incased by a fibrous coat. STRUCTURE OF THE KIDNEY.—The kidney consists of a mass of minute secretory tubes, intermixed with blood-vessels, lymphatics, nerves, and fine areolar tissue. The whole is incased by a fibrous coat.

Fibrous coat. The *fibrous coat* is a white firm case, which is connected with the kidney by fine processes and vessels, but is readily detached from it by slight force. At the inner margin of the kidney it sinks into the hollow or sinus, and sends processes on the entering vessels : at the same spot it is continuous with the fibrous coat of the excretory duct.

sends in offsets.

Some anatomists describe a *stroma* of areolar tissue in the kidney, which supports the secretory tubes and vessels, and is more evident in the pyramidal than the cortical substance.

Stroma described by some.

To obtain a knowledge of the anatomy of the secreting tubes, and to make out the disposition of the bloodvessels, the dissector will require a microscope and good fine injections of the part.

Secretory tubules.—The *uriniferous tubes* (*tubuli uriniferi*) are the ramified terminations of the excretory duct, which pour out the urine (fig. 87, *t*).

Uriniferous tubes.

In the cortex of the kidney, where the tubes present closed extremities (tubes of Ferrein), they are innumerable, are very convoluted, and of different sizes, though they average about $\frac{1}{500}$ th of an inch. They are closely surrounded by a plexus of bloodvessels, and communicate freely with one another.

In cortex of kidney; convoluted, surrounded by vessels.

In the pyramidal portion of the kidney a certain number of the tubes converge towards the base of each pyramid, and having become straight, are directed downwards as a conical bundle to the apex, where they open by somewhat dilated orifices. In the pyramid the tubes lie close together, and have but few vessels between them; they further diminish in number from base to apex by repeated unions, and are enveloped by a uniting or parenchymatous structure. On a section of a pyramid near the lower end, the number of tubes in a square line was estimated by Krause as a hundred.

In pyramid straight,

fewer in number with vessels;

have open mouths inferiorly,

Fig. 87.*



Structure of the wall of a tubule;

special membrane and epithelium.

Structure and ending of the tubes.—The tubes consist of a thin special basement membrane. Lining them is an epithelium of the spheroidal kind, which forms three-fourths of the thickness of the wall, except in the pyramid where it is thinner and the cells smaller and flatter. At the termination in free extremities each

tube presents a dilated or saccular part (fig. 87, *c*), which contains a small vascular Malpighian corpuscle, and is per-

* Plan of a urine tube provided with a terminal Malpighian body and capsule (Bowman).—*t*. The uriniferous tube. *c*. Dilatation or capsule of the Malpighian body continuous with the tube. *p*. Plexus of capillary vessels around the urine tube. *m*. Malpighian body. *a*. Branch of an artery; and *a'*, an offset from it (afferent vessel) to the Malpighian

forated by the two vessels connected with that body.* Into this little sac the epithelial lining extends, and becomes very delicate and translucent. Dilatations for the lodgement of the Malpighian bodies are connected with the sides, as well as the ends of the tubes.

Corpuscles
in the
tubules.

Size;
composed
of two
vessels.

The *Malpighian corpuscles* (glomeruli of Ruysch) are small, rounded or oblong vascular bodies in the cortical substance, which are contained in the dilated sacs of the uriniferal tubes (fig. 87, *m*). Each little vascular tuft has commonly a diameter of $\frac{1}{120}$ th of an inch, and is formed by the ramifications of two small vessels (*a'* and *e'*) that perforate the end of the containing tube. One vessel (afferent) is a small twig (*a'*) of the renal artery, which forms the exterior of the tuft by its branchings; the other (efferent) occupies the centre of the tuft (*e'*), and issuing from the tube ends in a plexus of capillaries on a neighbouring uriniferal tube. The glomerulus is free in the cavity of the tube.†

Blood vessels
are large,
and arteries
are peculiar.

BLOODVESSELS.—The artery and vein distributed to the kidney are very large in proportion to the size of the organ they nourish; and some small arterial branches have a peculiar disposition in the Malpighian bodies before they become capillary, and end in the veins.

Branches of
the artery

reach
exterior,

ramify on
tubules, and
form glome-
ruli.

Renal artery.—As the artery enters the kidney it divides into four or five branches, which are invested by sheaths of the fibrous capsule, and are transmitted to the cortical substance between the pyramidal masses. Some of the offsets of a chief branch enter the pyramidal mass, and ramify on the tubes, forming anastomotic loops parallel with them, whilst the continuation of the trunk (fig. 87, *a*), is distributed in the cortex around the pyramid. Some of the terminal twigs of the artery enter the Malpighian bodies before they become capillary, and the rest end in a plexus of capillaries around the uriniferal tubes.

Veins begin
around
tubules;

Renal vein.—This vein begins in the capillary plexuses on the convoluted urine tubes, and its larger branches are directed to the centre of the kidney, where they communicate around the pyramids, receiving veins from these

body. *e*. Branch of a vein, and *e'*, a radicle of the vein coming from the Malpighian body (efferent vessel), and joining in the plexus, *p*, around the urine tube.

* See a Paper in the Philosophical Transactions for 1842, Part I., On the Structure and Use of the Malpighian Bodies of the Kidney, by W. Bowman, F.R.S.

† According to Mr. Bowman this body is naked in the tube, but according to others it is covered with nucleated scales or an epithelium.

masses. From this spot the branches of the vein accompany those of the artery (fig. 87, e), and are united finally into one trunk that opens into the vena cava.

Some small vessels form an arborescent appearance on the surface of the kidney, and supply offsets to the capsule and the fat.

The URETER is the tube by which the fluid secreted in the kidney is conveyed to the bladder. Between its origin and termination the duct measures from sixteen to eighteen inches in length. Its size corresponds commonly with that of a large quill. Near the kidney it is dilated into a funnel-shaped part, named *pelvis*; and near the bladder it is again somewhat dilated, though the lower aperture by which it terminates is the narrowest part of the tube. Its relative anatomy must be studied afterwards, when the body is in a suitable position.

In its course from the one viscus to the other, the ureter is close beneath the peritoneum, and is directed obliquely downwards and inwards along the posterior wall of the abdomen as far as the pelvis; here it changes its direction and becomes almost horizontal in the posterior false ligament of the bladder. At first the ureter is placed over the psoas inclining on the right side towards the inferior vena cava, and about the middle of the muscle it is crossed by the spermatic vessels. Lower down it lies over the common or the external iliac artery,* being beneath the sigmoid flexure on the left side, and the end of the ileum on the right side. Lastly, it is contained in the posterior ligament of the bladder, below the level of the obliterated hypogastric artery.

Sometimes the ureter is found divided into two for a certain distance.

Part in the kidney.—Near the kidney the ureter is dilated into a pouch named *pelvis*; and when traced upwards into the viscus, it is found to begin by a set of cup-shaped tubes, named *calices* or *infundibula*, which vary in number from seven to thirteen. Each cup-shaped part embraces the rounded end of a pyramidal mass, and receives the urine from the apertures in that projection. Sometimes a calyx surrounds two or more papillæ. The several calices are united together to form two or three larger tubes;

* In a dozen uninjected bodies that were examined for me by the late Mr. S. F. Statham, the ureter was found as frequently over the one as the other of the two vessels mentioned.

and these are finally blended in the excretory duct or the ureter.

Two coats
in ureter,
muscular
and mucous.

Epithelium
many
layers.

The calices
also two
coats.

Structure.—Besides an external fibrous layer the ureter consists of a muscular and a mucous coat. The *muscular* covering is composed of an external or longitudinal, and an internal or circular stratum. The *mucous* coat is thrown into longitudinal folds during the contracted state of the ureter. Its epithelium consists of several layers of cells of different shapes; thus at the free and attached surfaces the cells are rounded; whilst in the intermediate strata they are cylindrical (Köl liker).

The *calices* resemble the rest of the duct in having a muscular and a mucous coat. Around the pyramid the enveloping tunic of the kidney is continuous with the calyx; and at its apex the mucous lining is prolonged into the uriniferous tubes through the small openings in the papilla.

THE SUPRARENAL CAPSULE.

Use
unknown.

This small body, whose use is unknown, has received its name from its position to the kidney. Its vessels and nerves are numerous, but it is not provided with any excretory duct.

No duct.
Situation.

One on each side, it is situated on the upper extremity and the fore part of the kidney; and without care it may be removed with the surrounding fat, which it is like. Its colour is yellowish. It resembles a cocked hat in form, and the upper part is convex, but the base or lower part where it touches the kidney is hollowed.

Form and
colour.

Size and
weight.

Its size in the adult is about one inch and a half in depth, and rather less in width; and its weight is between one and two drachms, but the left is commonly larger than the right capsule.

Connec-
tions.

Areolar tissue attaches the suprarenal body to the kidney; and large vessels and nerves retain it in situation. The connections with the surrounding parts are the same as those of the upper end of the kidney. Thus it rests on the diaphragm on both sides; whilst above the right body is the liver, and above the left the pancreas and the spleen. On the inner side of the right capsule is the vena cava, with part of the solar plexus; and internal to the left is the aorta, with the same plexus of nerves.

Two
different
structures.

Structure.—By means of a perpendicular section, the suprarenal body will be seen to be formed of a firm external

or cortical part, and of an internal (medullary) soft and dark material. The whole is surrounded by a thin *fibrous capsule*, which sends processes into the interior and along the bloodvessels. Surrounded by a capsule.

With the aid of a microscope this body is found to consist of a mass of cells, which are lodged in spaces formed in a stroma of areolar tissue. Each a stroma with cells.

Fig. 88.*



The *cortical part* (fig. 88, A) is yellowish in colour and striated, and forms about two-thirds of the thickness of the whole body. Its stroma consists of fine areolar tissue, Cortical part. Thickness

* A magnified representation of a vertical section of the suprarenal body.—A. Cortical part, with elongated fibrous meshes filled with cells. B. Medullary part, with a fibrous network and cells. C. Spaces inside the medullary portion. (Venous spaces, Harley). I am indebted to Dr. Harley for this illustration.

Its tissue forms spaces for masses of cells.	which builds up spaces elongated from without inwards, and arranged vertically around the centre. In the spaces or loculi columnar masses of cells are lodged, but slight force readily removes them from their containing hollows. A thin limiting membrane is said to line the spaces (Harley*).
Medullary part.	The <i>central</i> or medullary portion (fig. 88, B) is grayish or rather red in colour, or it may be dark brown or black from the presence of blood. About half as thick as the cortical part, it possesses internally small round or oval spaces
Thickness.	(fig. 88, C) (venous spaces, Harley), with sometimes a larger central hole resulting from the laceration of the substance.
Spaces in it.	In it the areolar tissue of the stroma forms a network with small but regular meshes for the lodgement of cells, instead of lengthened intervals as in the cortical part. Large cells, either single or in pairs, fill the meshes.
Its tissue forms a network for cells.	<i>Cells of the suprarenal body.</i> —The cells filling the loculi of the fibrous stroma are roundish in shape in the medullary part, and are nucleated and granular with some pigment and oil globules; but in the cortical part where they are packed in masses, they take on a polygonal form. They are rather smaller in the outer than in the inner part of the stroma, and have an average diameter of $\frac{1}{1250}$ th of an inch in the cortex, and $\frac{1}{1000}$ th of an inch in the medullary portion (Harley).
Characters of the cells.	<i>Bloodvessels.</i> —Numerous branches of <i>arteries</i> are furnished to the suprarenal body from the diaphragmatic and renal arteries, and from the aorta. In the interior of the body the arteries ramify in the cortical part along the fibrous septa between the cell masses, and frequently anastomosing together, end in a fine capillary network with elongated meshes around the cells. In the medullary part, the fine arteries, after ramifying through the stroma, end in capillaries with rounded intervals.
Size and diameter.	The <i>veins</i> originate in the capillary plexuses, and the several branches uniting in the medullary part, and communicating with the sinuses in it (Harley), are collected finally into a trunk, which opens on the right side into the vena cava, and on the left, into the renal vein. Other smaller veins pass out through the cortex to the renal vein and the cava.
Arteries.	<i>Nerves.</i> —The nerves are very numerous and large. In the medullary substance they form a network in the areolar structure, but their ending is unknown.
Veins.	
Nerves.	

* The Histology of the Suprarenal Capsules, by George Harley, M.D. Reprinted from *The Lancet*, 1858.

THE TESTES.

The testes are the glandular organs for the secretion of the semen. Each is suspended in the scrotum by the spermatic cord and its coverings (p. 495), but the left is usually lower than the right; and each is provided with an excretory duct named vas deferens. A serous sac surrounds partly each organ.

Testes situated in the scrotum.

Dissection.—For the purpose of examining the serous covering of the testicle (tunica vaginalis), make an aperture into it and inflate it. The surface of both the sac and the spermatic cord are then to be cleaned, and the vessels of the latter are to be followed to their entrance into the testicle.

To see the serous sac.

The *tunica vaginalis* is a serous bag, which is continuous in the fetus with the peritoneal lining of the abdomen, but becomes subsequently a distinct sac in consequence of the obliteration of the tube connecting the two. It invests the testicle after the manner of other serous membranes; for the testicle is placed behind it, so as to be partly enveloped by it, and not in its cavity. The sac, however, is larger than is necessary for covering the testicle, and projects some distance above it. Like other serous membranes, it has an external rough, and an internal secreting smooth surface; and like them it has a visceral and a parietal part. To examine its disposition the sac should be opened.

Serous bag

partly covers the testicle,

and lines scrotum.

The visceral layer (*tunica vaginalis testis*) covers the testicle except posteriorly where the vessels lie, and is inseparably united with the fibrous coat. On the outer side it extends farther back than on the inner, and passes between the testis and the arched body (epididymis) that lies on this aspect of the organ.

its visceral part,

The parietal part of the sac (*tunic. vagin. scroti*) is more extensive than the piece covering the testicle, and lines the immediately contiguous layer of the scrotum.

and parietal.

Form and position of the testis.—The testicle is oval in shape, with a smooth surface, and is flattened on the sides. The anterior margin is convex; and the posterior, which is flattened, is pierced by the spermatic vessels and nerves. Stretching like an arch along the outer part of the testis is the epididymis, or the convoluted part of the excretory duct, and attached to the upper part of the testis, or of the epididymis, is a very small body, two or three lines in length, whose use is unknown.

Testicle oval.

Margins.

Bodies on the testicle.

Suspended obliquely. The testis is suspended obliquely, so that the upper part is directed forwards and somewhat outwards, and the lower end backwards and rather inwards.

Dimensions and weight. *Size and weight.*—In length the testis is an inch and a half or two inches; from before backwards it measures rather more than an inch; and from side to side rather less than an inch. Its weight is nearly an ounce, and the left is frequently larger than the other.

A dense tunic contains small secreting tubes. **STRUCTURE.**—The substance of the testicle is composed of a mass of minute secreting tubes, around which the blood-vessels are disposed in plexuses. Surrounding and supporting the delicate seminiferous tubes is a dense covering—the tunica albuginea. Its excretory or efferent duct is named vas deferens.

How to see the structure of the testis. *Dissection.*—With the view of examining the investing fibrous coat, let the testis be placed on its outer side, viz. that on which the epididymis lies, and let it be fixed in that position with pins. The fibrous coat may be cut through along the anterior part, and thrown backwards as far as the entrance of the bloodvessels. Whilst raising this membrane a number of fine bands will be seen traversing the substance of the testicle, and a short septal piece (mediastinum) will be observed at the back of the viscus, where the vessels enter. It will be necessary to remove part of the mass of tubes in the interior, to bring into view the mediastinum, and to trace back some of the finer septa to it.

Fibrous coat; characters; use. The *tunica albuginea*, or the fibrous coat of the testicle, is of a bluish-white colour, and resembles in appearance the sclerotic coat of the eyeball. This membrane supports the soft secreting part of the testicle, and maintains the shape of the organ by its dense and unyielding structure. Besides determining the general form, it sends inwards processes to support and separate the seminal tubes. These several offsets of the membrane are seen in the dissection that has been made; and one of them, which is larger than the rest, is placed at the back of the testicle, and is named mediastinum.

Sends inwards processes, as the mediastinum. The *mediastinum testis* (corpus Highmorianum) projects into the gland for the distance of a few lines with the blood-vessels. It is situate at the back of the testis, extending from the upper nearly to the lower part, and is larger and deeper above than below. When cut across it will be seen to be formed of two lateral pieces, which are united anteriorly at an acute angle. To its front and sides the finer septal processes are connected; and in its interior are con-

tained the bloodvessels, and a network of seminal ducts forming the rete testis.

Of the *finer processes* of the tunica albuginea, which enter and the testis, there are two kinds. One set round and cord- finer septa. like, but of different lengths, are fixed posteriorly to the mediastinum, and serve to maintain the shape of the testis. The other set form delicate membranous septa, which divide the seminal tubes into masses named lobes, and are continued like the rest to join the mediastinum.

Tunica vasculosa.—Within the tunica albuginea is a thin A vascular layer lines it (tunica vasculosa). vascular layer, which has been named as above by Sir A. Cooper. It lines the fibrous coat, covering the different septa in the interior of the gland. It is formed of the ramifications of the bloodvessels united by areolar tissue, like the pia mater of the brain: and in it the arteries are subdivided before they are distributed on the secerning tubes, and the veins in the interior are supported by it.

Form and length of the seminal tubes (tubuli seminiferi).— Seminal tubules; appearance and length. The secerning or seminal tubes are the minute branched extremities of the duct or vas deferens. They are very wavy, and are but slightly held together by fine areolar tissue and surrounding bloodvessels, so that they may be readily drawn out of the testis for some distance. Their length is said by Monro to be sixteen feet, but by Lauth to be only two feet and a quarter. The size and the characters of the minute tubules can be learned only with the aid of the microscope.

Ending, size and structure.—Towards the circumference of the testis, the tubes have for the most part distinct closed extremities; but some communicate, forming loops or arches, and others are united deeper in the gland. The Communications; size; structure; diameter of the tubules varies from $\frac{1}{200}$ th to $\frac{1}{150}$ th of an inch. The wall of the tubuli is formed of a thin, fibrous membrane, but it has considerable strength: lining the interior is a nucleated granular epithelium, with polygonal cells; and on the exterior is a plexus of bloodvessels.

Names from the arrangement of the tubes.—To different Tubes change their name. parts of the seminal tubes between the origin and ending the following names have been applied. Where the tubules are collected into separate masses, they form the lobes of the testis. As they enter the fibrous mediastinum they become straight, and are named tubuli recti. Communicating in the mediastinum, they produce the rete testis. And, lastly, as they leave the upper part of the gland they

become convoluted, and are called *coni vasculosi*, or *vasa efferentia*.

They form the lobes.

Number of lobes.

Shape.

Tubes in them, and arrangement.

The lobes of the testis (fig. 89, *a*) are formed by bundles of the seminiferal tubes; and they are situate in the intervals between the processes sent inwards from the tunica albuginea. Their number is differently stated:—according to one authority (Berres) they are 250; but according to another (Krause), 400 or more. They are conical in form, with the base of each at the circumference, and the apex at the mediastinum testis. Each is made up of one, two or more tortuous seminal tubules; and the minute tubes in one lobe are united sometimes with those in the neighbouring lobes. Towards the apex of each lobe the tubules become less bent, and are united together; and the tubuli of the several lobes are further joined at the same spot into larger canals that form the tubuli recti.

Fig. 89.*



Tubes next become straight (tubuli recti);

afterwards join together (rete testis),

and leave the gland as vasa efferentia.

Tubuli recti.—The seminal tubes issuing from the several lobes unite together, becoming larger in size and straighter in direction, and are named tubuli recti or vasa recta (fig. 89, *b*): they are about twenty in number, and piercing the fibrous mediastinum enter into its interior.

Rete testis.—In the mediastinum the excretory tubes are situate in the anterior part in front of the bloodvessels, and communicate freely so as to form a network, the rete testis (fig. 89, *c*).

Vasa efferentia.—About twelve or twenty seminal tubes issue from the top of the rete testis, and leave the upper part of the testicle as the vasa efferentia (fig. 89, *d*). These are larger than the tubes with which they are continuous, and end in the common excretory duct. Though straight at first they soon become convoluted, and have been named *coni vasculosi*. When they are unravelled they are from six

* Plan of the testicle as seen on a vertical section.—*f*. Fibrous coat of the testicle. *s*. Mediastinum. *i, i*. Processes of external coat, continued between the lobes. *a, a*. Lobes of the testis. *b*. Tubuli recti. *c*. Rete testis. *d*. Vasa efferentia. *f, e, g*. Coils of the tube forming the epididymis. *h*. Vas deferens.

to eight inches long; and they join the excretory duct at intervals of about three inches.

The EXCRETORY DUCT of the testis receives the vasa efferentia from the upper part of the gland, and extends thence to the urethra. Its first part, which is in contact with the testis, is very flexuous, and forms the epididymis: but the remainder is straight, and is named vas deferens. Excretory duct

The *epididymis* extends in the form of an arch, along the outer side of the testis, from the upper to the lower end, and receives its name from its situation. Opposite the upper part of the testicle it presents an enlarged portion or head, the *globus major*; and at the lower part of that organ it becomes more pointed or tail-like—*globus minor*, before ending in the vas deferens. The intervening narrow part of the epididymis is called the body. Its head is attached to the testis by the vasa efferentia; and its tail or lower part is fixed to the tunica albuginea by some fibrous tissue, and by the reflection of the tunica vaginalis. After the removal of the serous membrane and some fibrous tissue, the epididymis may be seen to be formed of a single tube, bent into a zigzag form, whose bends are united into one mass by fibrous tissue. This part of the tube, when uncoiled, measures twenty feet in length. The diameter of its canal is about $\frac{1}{70}$ th of an inch; but there is a slight diminution in size towards the *globus minor*. is bent on the testicle forming epididymis.
Its parts.
Is but a single tube;
length and size.

The *vas deferens* begins opposite the lower end of the testis, at the termination of the *globus minor* of the epididymis. At first this part of the excretory duct is slightly wavy, but afterwards it becomes for the most part a firm round tube. In its course to the urethra, it ascends on the inner side of the testicle and along the bloodvessels of the spermatic cord, with which it enters the internal abdominal ring; it is then directed over the side of the bladder, and through the prostate to open on the inner surface of the latter (p. 612). The length of this part of the excretory duct is about two feet, and the width of its canal about $\frac{1}{30}$ th of an inch. Near its termination the vas deferens becomes enlarged and tortuous; but this condition will be referred to with the viscera of the pelvis. Where it is straight it is the vas deferens;
this opens into the urethra;
length and size.

Opening sometimes into the vas deferens, at the angle of union with the epididymis, is a small narrow cæcal appendage, the *vas aberrans* of Haller. It is convoluted, and projects upwards for two or three inches amongst the vessels of the cord. Like the epididymis, it is much longer when it is unravelled, measuring sometimes fourteen inches; and size. Vas aberrans occasionally present; situation

but it may not exceed an inch and a half in length. Its capacity is greatest at the free end. Its use is unknown. The vas aberrans may be found divided or doubled.

Two coats
form the
duct;

Structure.—The excretory duct of the testis is formed chiefly by a thick muscular coat, which is covered externally by fibrous tissue, and lined internally by mucous membrane. To the feel the duct is firm and wiry, like whip-cord. On a section its wall is dense and of a rather yellow colour, but it is thinnest at the head of the epididymis.

a muscular

The *muscular coat* is composed of longitudinal and circular fibres arranged in strata, so that both externally and internally is a longitudinal layer, the latter being very thin; and between them is the layer of circular fibres.

and a
mucous.

The *mucous membrane* is marked by longitudinal ridges in the straight part of the canal, and by irregular ones in the sacculated portion. A pavement epithelium, with brown pigment granules in the cells (Köl liker), covers the inner surface, but in the epididymis and the vasa efferentia the epithelium is said to be cylindrical and ciliated. (Becker.)

Vas aberrans
like the
duct.

The canal of the vas deferens is larger than that of the epididymis, as before stated. The vas aberrans resembles the vas deferens in structure.

Organ of
Giraldès.

*Organ of Giraldès.**—In the spermatic cord, close above the epididymis, is a small whitish granular looking body ("Corps Innominé," Giraldès), about half an inch long, which is considered by its discoverer to be the remains of the Wolffian body of the embryo. With magnifying power its component white granules or specks are resolved into small vesicles, and convoluted tubes of varying shape, with plexuses of bloodvessels ramifying on the exterior. The wall of both vesicles and tubes consists of a thin fibrous membrane, lined by flattened epithelium. In the interior is a clear and thick fluid with transparent granules in it. After about the sixth year this body begins to diminish.

Remains of
Wolffian
body.

Constituents.

Structure.

Contents.

Spermatic
artery.

Bloodvessels and nerves of the testicle.—The branches of the *spermatic artery* pierce the back of the testis, and enter the posterior part of the mediastinum behind the rete testis. Leaving the mediastinum, the vessels are finely divided in the vascular membrane lining the interior of the tunica albuginea. After being thus divided offsets are continued

* Sur un Organe placé dans le Cordon Spermatique, et dont l'existence n'a pas été signalée par les Anatomistes—Par F. Giraldès. Proceedings of the Royal Society for May, 1858.

on the fine septa between the lobes to the seminal tubules, on which they are distributed in plexuses.

The *spermatic vein* begins in the plexuses around the seminal tubes, and issues from the gland at the posterior part. As it ascends along the cord, its branches form the spermatic plexus, and end in one trunk, which joins the vena cava on the right side, and the renal vein on the left (p. 592).

The *lymphatics* ascend on the bloodvessels, and join the lymphatics lumbar glands.

The *nerves* are derived from the sympathetic, and accompany the arteries to the testis.

Vessels of the vas deferens.—A special bloodvessel, the artery of the *vas deferens*, is furnished from the upper vesical artery; and some veins from the *epididymis* enter the spermatic vein.

Spermatic vein.

Vessels of the duct.

SECTION V.

AORTA AND VENA CAVA, AND THE DEEP MUSCLES.

Directions.—After the body is replaced in its former position on the back, the student should prepare first the diaphragm, next the large vessels and their branches, and then the deep muscles of the abdomen.

Dissect bloodvessels and muscles.

Dissection.—For the dissection of the diaphragm it will be necessary to remove the peritoneum from its under surface, defining especially the central tendinous part, and the fleshy processes or pillars which are fixed to the lumbar vertebrae. Whilst cleaning the surface the student should be careful of the vessels and the nerves on it and near the pillars. On the right side two aponeurotic bands or arches, which give attachment to the muscular fibres, should be dissected out:—one curves over the *psoas* muscle; and the other extends over the *quadratus* muscle from the transverse process of the first lumbar vertebra to the last rib.

To see the diaphragm.

The *DIAPHRAGM* (fig. 90) forms the vaulted moveable partition between the thorax and the abdomen. It is fleshy externally, where it is attached to the surrounding ribs and the spinal column, and has its tendon in the centre. The *origin* of the muscle is at the circumference, and is similar on each side of the middle line. Thus, beginning in front and passing backwards, the diaphragm is connected by fleshy fibres with the posterior part of the xiphoid cartilage, and

Diaphragm. Situation and form.

Origin at the circumference.

with the inner surface of the six lower ribs ; with two aponeurotic arches between the last rib and the spinal column—one being placed over the quadratus lumborum, and the other over the psoas muscle ; and, lastly, it is connected with the lumbar vertebræ by a thick muscular part or

Fig. 90.*



pillar. From this extensive origin the fibres are directed inwards, with different degrees of obliquity and length, to the central tendon, but some have a peculiar disposition in the pillars which will be afterwards noted.

The abdominal surface is concave, and is covered for the most part by the peritoneum. In contact with it on the right side, are the liver and the kidney ; and on the left side, the stomach, the spleen, and the left kidney : in contact also with the pillars is the pancreas, together with the solar plexus and the semilunar ganglia. The thoracic surface is covered by the pleura and the pericardium, and is convex towards the thorax (p. 403). At the circumference of the muscle the fleshy processes of origin alternate with like parts of the transversalis muscle. A slight interval separates the slips to the xiphoid cartilage and seventh rib ;

* Under surface of the diaphragm.—1. External arched ligament. 2. Internal arched ligament. 3, 4. Psoas muscles. 5. Central part. 6. Left, and 7. Right piece of the cordiform tendon. 8. Opening for the vena cava. 9. Right crus. 10. Left crus. 11. Opening for the aorta. 12. Opening for the oesophagus.

and a second interval exists sometimes between the fibres from the last rib, and those from the arch over the quadratus lumborum muscle. In the diaphragm are certain apertures for the transmission of parts from the thorax to the abdomen, viz., one for the œsophagus, another for the vena cava, and a third for the aorta between the pillars of the muscle and the spinal column: moreover, the pillars are perforated by the splanchnic nerves.

The muscle is curved across the interthoracic space, being Arch. convex towards the chest, and concave to the abdomen; and the arch reaches higher on the right than the left side (p. 352). The height of the arch is constantly varying Height in forced expiration during life with the change in the condition of the diaphragm in respiration. In forced expiration the muscle ascends and reaches the upper border of the fourth rib on the right, and the fifth rib on the left side. In forced inspiration it descends, and its slope would be represented by a line and inspiration. drawn from the ensiform cartilage towards the tenth rib.

The following parts, which have been mentioned only incidentally in describing the diaphragm, are now to be noticed more fully; they are the central tendon, the pillars, the arches, and the apertures. Special parts to be examined.

The *central tendon* (tendo diaphragmatis, cordiform tendon), occupying the middle of the diaphragm (fig. 90), is surrounded by muscular fibres, and the large vena cava pierces it. It is of a pearly white colour, and its tendinous fibres cross in different planes and different directions. In form it resembles a trefoil leaf; of its three segments the right one (⁷) is the largest, whilst the left is the smallest. Central tendon, like a trefoil leaf.

The *pillars* (crura, appendices) are two large muscular and tendinous processes (fig. 89, ^{9, 10}), one on each side of the abdominal aorta. They are pointed and tendinous below, where they are attached to the upper lumbar vertebræ, but large and fleshy above; and between them is a tendinous arch over the aorta. In each pillar the fleshy fibres pass upwards and forwards, diverging from each other; and the greater number join the central tendon without intermixing. But the internal fibres of the opposite sides cross one another in the following manner:—Those of the right side for instance (⁹) ascend by the side of the aorta, and pass to the left of the middle line, decussating with their fellows between that vessel and the opening of the œsophagus; having changed sides, the fibres are directed upwards to the central tendon around the œsophagean opening, which they limit on the left. The fibres of the other crus (¹⁰) may be traced in the Two pillars, with certain resemblances. Arrangement of fibres in each, as they ascend to the tendon.

vessel with surrounding parts have been before referred to (p. 531), and its branches remain to be examined.

Place of
origin of
the
branches ;

The *branches* of the aorta are numerous, and arise in the following order :—First, are the diaphragmatic arteries, two in number, which leave the sides of the vessel immediately it appears in the abdomen. Close to the tendinous ring of the diaphragm the single trunk of the coeliac axis arises from the front of the aorta. And about a quarter of an inch lower down, also on the front, the trunk of the superior mesenteric artery begins. Half an inch lower the renal arteries, right and left, take origin from the sides of the aorta. On the fore part of the vessel, close above each renal, is the small capsular branch ; and below the renal is the spermatic artery. From the front of the aorta, one to two inches above the bifurcation, springs the inferior mesenteric artery ; and from the angle of division the small middle sacral artery runs downwards. Four or five small lumbar branches on each side come from the posterior part of the vessel, opposite the bodies of the lumbar vertebræ.

their classi-
fication.

The branches may be classified into two sets—one to the viscera of the abdomen (visceral), and another to the abdominal wall (parietal).

Visceral
branches.

A. The *visceral branches* are coeliac axis, superior and inferior mesenteric, renal, capsular, and spermatic. All this set, except the last three, viz., the renal, capsular, and spermatic, have been examined (pp. 525, 535).

Renal
artery,

The *renal arteries* leave the aorta nearly at a right angle, and are directed outwards, one on each side. Near the kidney each divides into four or five branches, which enter the renal substance between the vein and the ureter. Each artery lies beneath its companion vein, being surrounded by a plexus of nerves, and supplies small twigs to the suprarenal capsule (inferior capsular), to the ureter, and to the fatty layer about the kidney.

is beneath
its vein ;
gives offsets.

Difference
between
left and
right.

The arteries of opposite sides have some differences. The left is the shortest, owing to the position of the aorta. The right crosses the spine, and passes beneath the vena cava. Varieties in both the number and place of origin of this artery are frequent.

Capsular
artery.

The *middle capsular artery* is a small branch that runs almost transversely outwards to the suprarenal body to which it is distributed. This offset anastomoses with the other branches supplied to the suprarenal body by the renal and phrenic arteries. It is of large size in the fetus.

Spermatic

The *spermatic artery* is destined for the testicle. It is

the large azygos vein pierces the right pillar instead of passing with the aorta.

Dissection.—After the diaphragm has been learnt, the ribs that support it on each side may be cut through, and the pieces of the ribs together with the fore part of the diaphragm may be taken away to make easier the dissection of the deeper vessels and muscles. But the posterior part of the diaphragm, with the pillars and arches, should be left, and its vessels should be traced back to their origin.

Take away greater part of the diaphragm.

The large vessels of the abdomen, viz., the aorta and the vena cava, are to be cleaned by removing the fat, with the remains of the sympathetic and the lymphatic glands; and their branches are to be followed to the diaphragm, to the kidney and the suprarenal body, to the testicle, and to the lumbar vertebrae and the spinal cord. In like manner the large iliac branches of the aorta and cava are to be laid bare as far as Poupart's ligament. The ureter and the spermatic vessels are to be cleaned as they cross the iliac artery; and on the artery branches of a small nerve (genito-crural) are to be sought near the thigh.

Clean aorta, cava, and branches.

The psoas, quadratus, and iliacus muscles are to be dissected on the right side; but on the left side the fascia covering the muscles is to be shown, and the fat is to be cleared away from about the kidney. The psoas muscle is the most internal, and lies on the side of the spine: on its surface, and in the fat external to it, branches of the lumbar plexus will be found:—The genito-crural nerve lies on the front; and four other nerves issue at the outer border—the ilio-hypogastric and ilio-inguinal near the top, the external cutaneous about the centre, and the large anterior crural at the lower part. Along the inner border of the psoas the gangliated cord of the sympathetic is to be sought with a chain of lumbar lymphatic glands; and somewhat below the pelvic part of the muscle, the obturator nerve may be recognised. External to the psoas is the quadratus lumborum muscle, and crossing it near the last rib is the last dorsal nerve, with an artery. In the hollow of the hip-bone is the iliacus muscle.

Dissect psoas.

Nerves of lumbar plexus.

Dissect quadratus lumborum and iliacus.

The ABDOMINAL AORTA extends from the last dorsal vertebra to the left side of the body of the fourth lumbar vertebra, where it divides into the common iliac arteries. Its commencement is between the pillars of the diaphragm, and its termination is nearly on a level with the highest part of the crest of the hip bone. The connections of the

Extent of the aorta.

Connections.

vessel with surrounding parts have been before referred to (p. 531), and its branches remain to be examined.

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origin of
the
branches ;

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is beneath
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Difference
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left and
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Spermatic

The *spermatic artery* is destined for the testicle. It is

remarkable for its small size in proportion to its length ; for leaving the cavity of the abdomen ; and for having the part in the abdomen straight, but that in the cord tortuous. From its origin below the renal, the vessel passes downwards along the posterior wall of the abdomen to the internal abdominal ring, where it enters the spermatic cord, as before described (p. 496). In its course beneath the peritoneum the vessel passes first along the front of the psoas, crossing over the ureter ; and as it leaves the abdomen it turns round the epigastric artery, but is separated from that vessel by the vas deferens. On the right side the artery crosses the vena cava. It is accompanied by the spermatic vein, and the spermatic plexus of nerves.

artery is remarkable.

Course to the testicle.

In the fetus before the testicle leaves the abdomen the spermatic artery is very short, but the vessel becomes elongated in proportion as the part supplied is removed from its former site.

Condition in the fetus.

In the female the corresponding artery (ovarian) descends into the pelvis to the ovary and the uterus.

In the female.

B. The *parietal branches* of the aorta are the diaphragmatic, lumbar, and the middle sacral arteries.

Branches to wall of abdomen.

The *diaphragmatic* or *inferior phrenic arteries* are directed upwards and outwards along the under surface of the diaphragm near the posterior part, and end in anastomotic and muscular branches. The left artery passes behind the oesophageal opening, and the right behind the vena cava. Each ends in two branches :—One (internal) passes onwards towards the fore part of the diaphragm, and anastomoses with its fellow, and with the branches (musculo and superior phrenic) supplied to the diaphragm from the internal mammary (p. 274). The other (external) is larger, and is directed outwards to the side of the muscle, where it meets with the intercostal arteries.

Inferior phrenic ;

course of left and right.

Distribution.

Branches.—Small offsets supplied to the suprarenal body by the external division of this artery are named *superior capsular*. Some twigs are given by the left artery to the oesophagus, and by the right to the vena cava.

Small offsets.

The other parietal branches, viz., lumbar and middle sacral, are not learnt in this stage : the former will be seen after the lumbar plexus (p. 601), and the latter in the pelvis.

The COMMON ILIAC ARTERY is directed outwards from the bifurcation of the aorta, and divides into two large trunks opposite the fibro-cartilage between the base of the sacrum and the last lumbar vertebra :—one of these supplies the

Common iliac ; extent and termination.

- Difference in length and connections.** The right vein is the shortest, and is at first behind, but afterwards outside the artery of the same side. The left is altogether below the artery of its own side, and moreover crosses beneath the right common iliac artery.
- Veins to it.** Each vein receives the ilio-lumbar, and sometimes the lateral sacral branch : and the common iliac of the left side is joined by the middle sacral vein.
- Place where the veins join may change.** Instead of the common iliac veins uniting at the spot mentioned, they may be continued upwards, one on each side of the aorta, as high as the kidney, before the left crosses the spine to join the right and give origin to the vena cava. In these cases the left vein receives the renal vein of the same side, and the two common iliacs are connected by a small intervening branch at the spot where they are usually united.
- Lower cava is by side of the aorta.** The *VENA CAVA INFERIOR* collects, and conveys to the heart the blood of the lower half of the body. Taking origin, as before said, on the right side of the fifth lumbar vertebra, rather below the bifurcation of the aorta, this large vein ascends on the right side of the vertebral column, and reaches the heart by perforating the diaphragm. Its connections with the surrounding parts have been already described (p. 532).
- Extent and connections.**
- Branches from abdomen,** *Branches.*—The cava receives parietal branches from the wall of the abdomen and the diaphragm ; and visceral branches from the testicle, the kidney, the suprarenal body, and the liver.
- except those of digestive apparatus.** The veins belonging to the digestive apparatus, viz. to the intestinal canal, the spleen, and the pancreas, are united to form the *vena portæ* (p. 538) ; and the blood circulating in those veins reaches the cava by the *venæ cavæ hepaticæ* after it has circulated through the liver.
- Lumbar veins.** The *lumbar veins* enter the posterior part of the vena cava, and correspond in number and course with the arteries of the same name : they will be dissected with those arteries.
- Spermatic vein** The *spermatic vein* enters the abdomen by the internal abdominal ring, after forming the spermatic plexus in the cord (p. 496). At first the vein consists of two branches in the abdomen, which lie on the sides of the spermatic artery ; but these soon join into one trunk. On the left side the spermatic vein opens into the renal vein at right angles ; and on the right side it pierces obliquely the inferior cava below the renal vein. As the vein ascends to its destination, it receives one or more branches from the wall of the abdomen, and from the fat about the kidney.
- ends differently on left and right sides.**

In the female this vein (ovarian) has the same ending as in the male, and it forms a plexus in the broad ligament of the uterus. Vein in the female.

The renal or *emulgent vein* is of large size and joins the vena cava at a right angle. It commences by many branches in the kidney; and the trunk resulting from their union is superficial to the renal artery. Renal vein; position to artery;

The right is the shortest, and joins the cava higher up than the other. The left vein crosses the aorta close to the origin of the superior mesenteric artery; it receives separate branches from the spermatic and suprarenal veins of the same side. difference on two sides.

The *suprarenal vein* is of considerable size when it is compared with the body from which it comes. On the right side it opens into the cava, and on the left side into the renal vein. Suprarenal ends differently on each side.

The *diaphragmatic veins* (inferior), two for each artery, spring from the under surface of the diaphragm. They join the cava either as one trunk or two. Phrenic veins.

The *hepatic veins* enter the cava where it is in contact with the liver. These veins are described in the dissection of the liver (p. 566). Hepatic veins, before noticed.

Peculiarities of the vena cava.—*In position.*—When transposition of the viscera exists, the vena cava is found on the left of the spine. But without that transposition the vein may begin on the left side of the spine, and remain on the left of the aorta as high as the renal vein before it crosses that vessel to take its usual place. Vena cava may be also on left side, or in part,

In ending.—Instead of opening into the heart, the lower cava may be found entering the upper cava; and in these rare instances it lies in the situation of the intercostal or azygos vein. In this condition the inferior cava is wanting at the heart, and the blood from the lower part of the body is transmitted to the heart by the superior cava. When this deviation exists, the hepatic veins form a separate trunk, and open into the right auricle in the situation of the inferior cava. or may end in the azygos vein.

DEEP MUSCLES OF THE ABDOMEN.

The deep muscles in the interior of the abdomen are the psoas, iliacus, and quadratus lumborum. Some fasciæ are to be seen in connection with the muscles.

The *PSOAS MAGNUS* reaches from the lumbar vertebræ to the femur, and is situate partly in the abdomen and partly in the thigh. The muscle *arises* from the front of the transverse processes (parapophyses) of the lumbar vertebræ; from the bodies of the last dorsal and all the lumbar vertebræ by five processes—each process being connected with the inter- Psoas magnus; situation; origin.

vertebral substance, and the borders of the two contiguous vertebræ : and from tendinous bands over the bloodvessels opposite the middle of the vertebræ. The fibres are directed downwards, and give rise to a roundish muscle, which gradually diminishes towards Poupart's ligament. Inferiorly the muscle ends in a tendon on the outer aspect, which receives fibres of the iliacus, and passes beneath Poupart's ligament to be *inserted* into the small trochanter of the femur.

Connections
in front,

behind.

Of outer
border,

of inner
border

along pelvis.

Psoas
parvus ;

origin ;

insertion ;

often ab-
sent.

Iliacus has
the form of
the iliac
fossa.

Origin ;

insertion.

Parts cover-
ing it on
opposite
sides.

The abdominal part of the musclè has the following connections :—In front are the internal arch of the diaphragm, the kidney with its vessels and duct, the spermatic vessels and the genito-crural nerve, and, near Poupart's ligament, the ending of the external iliac artery. Posteriorly the muscle is in contact with the transverse processes, with part of the quadratus lumborum and with the innominate bone. The outer border touches the quadratus and iliacus ; and branches of the lumbar plexus issue from beneath it. The inner border is partly connected to the vertebræ, and is partly free along the margin of the pelvis :—along the attached or vertebral part of this border lie the sympathetic nerve and some lumbar glands, with the cava on the right, and the aorta on the left side ; along the free or pelvic part are the external iliac artery and vein, and the obturator nerve below.

The PSOAS PARVUS is a small muscle with a long and flat tendon, which is placed on the front of the large psoas ; but it is rarely present. Its fibres *arise* from the bodies of the last dorsal and first lumbar vertebræ, and from the intervening fibro-cartilage, like the large psoas. Its tendon becomes broader inferiorly, and is *inserted* into the ilio-pectineal eminence and the brim of the pelvis. The tendon is connected with the fascia covering the iliacus muscle.

The ILIACUS MUSCLE occupies the hollow (iliac fossa) on the inner aspect of the hip bone, and is blended inferiorly with the psoas muscle. It is triangular in form, and has a fleshy *origin* from the iliac fossa and the ilio-lumbar ligament, from the base of the sacrum, and from the capsule of the hip joint in front. The fibres pass inwards to the tendon of the psoas, uniting with it even to its *insertion* into the femur, and some reach separately that bone.

Above Poupart's ligament the muscle is covered by the iliac fascia ; but placed over the right iliacus is the cecum, and over the left muscle is the sigmoid flexure. Beneath it are the innominate bone and the capsule of the

hip joint; and at the grooved anterior margin of the bone above the joint is a bursa. The inner margin is in contact with the psoas and the anterior crural nerve.

To the inner side is the psoas.

The connections of the united psoas and iliacus below Poupart's ligament are given with the dissection of the thigh.

The **QUADRATUS LUMBORUM** is a short thick muscle between the crest of the hip bone and the last rib. About two inches wide inferiorly, it arises from the ilio-vertebral ligament, and from the iliac crest of the hip bone for the same extent as that band but behind it. The fibres ascend to be inserted into the body of the last dorsal vertebra, and the lower border of the last rib for a variable distance: and by distinct fleshy and tendinous slips into the apices of the transverse processes of the four upper or all the lumbar vertebræ. This muscle is encased in a sheath derived from the fascia lumborum. Crossing the surface are branches of the lumbar plexus, together with the last dorsal nerve. Beneath the quadratus is the mass of the erector spinæ muscle.

Quadratus lumborum. Origin.

Insertion.

It is contained in a sheath.

Occasionally there is an anterior stratum of fibres at the upper part, which is attached internally to the tips of the transverse processes of the three middle lumbar vertebræ, and externally to the lower border of the last rib.

Inner or anterior part.

Fascia of the quadratus.—Covering the surface of the quadratus is a thin membrane, which is derived from the hinder aponeurosis of the transversalis abdominis (fascia lumborum, p. 420), and passes in front of the quadratus to be fixed to the roots of the transverse processes; below to the ilio-lumbar ligament; and above to the last rib. This fascia forms the thickened band called *ligamentum arcuatum externum*.

Fascia of the quadratus.

Fascia of the iliacus and psoas.—A fascia covers the two flexor muscles of the hip joint, and extends in different directions as far as their attachments. Over the iliacus muscle the membrane is thickest; and a strong accession is received from the tendon of the small psoas; its disposition at Poupart's ligament, and the part that it takes in the formation of the crural sheath, have been before explained (p. 509). Traced inwards over the psoas, the membrane will be found to be inserted into the hip bone near the brim of the pelvis. When followed upwards it will be seen to become thin, and to be fixed on the one side to the lumbar vertebræ and the *ligamentum arcuatum internum*, but to blend on the other with the fascia on the quadratus. At

Iliac fascia

joined by tendon of small psoas; attachments below;

internally both to pelvis

and the
vertebræ. its attachment to the vertebræ it has the same digitate and arched condition as the psoas. The fascia should be divided over the psoas on the left side, and reflected towards the brim of the pelvis.

Trace the
lymphatics, *Dissection.*—The student is now to clean the lymphatic glands that lie along the vertebræ, and to trace upwards some lymphatic vessels to the thoracic duct. To show the origin of the duct the diaphragm is to be divided over the aorta, and its pillars are to be thrown to the sides; then a piece may be cut out of the aorta opposite the first lumbar vertebra. The beginning of the duct (chyli receptaculum) and of the vena azygos may be well seen now; and the two may be followed upwards into the thorax.

and the
receptacu-
lum, On the left side the student may trace the splanchnic nerves and the small vena azygos through the pillar of the diaphragm, and show the trunk of the sympathetic nerve entering the abdomen beneath the arch over the psoas muscle.

splanchnic
nerves. *Lymphatic glands.*—A chain of glands is placed along the side of the external iliac artery, and along the front and sides of the lumbar vertebræ; they are connected by short tubes, which increase in size and diminish in number until at the upper part of the lumbar vertebræ only three or four trunks remain to form the thoracic duct. Into these glands the lymphatics of the lower limb, of the viscera and wall of the abdomen, and of the genital organs and testicle are received.

Lumbar
lymphatics
of the abdo-
men *Receptaculum chyli.*—The thoracic duct begins in the abdomen, by the union of three or four large lymphatic vessels. Its commencement is marked by a considerable dilatation, which is named receptaculum chyli, and is placed on the right side of the aorta, about opposite the second lumbar vertebra. The duct enters the thorax by passing through the diaphragm with the aorta.

end in one
duct. *Beginning of the azygos veins.*—The right vein (vena azygos major) begins opposite the first or second lumbar vertebra by a small branch, which is continuous with a lumbar vein, or joins the vena cava or the renal vein. However formed, the vein enters the thorax with the thoracic duct and the aorta, to the right of which it lies; but it may pierce the crus of the diaphragm as it leaves the abdomen. The left or small azygos vein begins on the left side of the spine, joining one of the lumbar veins or the renal vein, and passes through the pillar of the diaphragm, or through the aortic opening.

Lymphatics
entering
glands. *The anatomy of these veins is given in the description of the thorax, p. 396.*

Beginning
of the tho-
racic duct, at second
lumbar
vertebra. Large azy-
gos vein; entrance
into thorax. Small azy-
gos vein.

SECTION VI.

LUMBAR SPINAL NERVES AND THE CORD OF THE SYMPATHETIC.

The spinal nerves of the loins resemble those in the lower part of the neck in being united in a plexus, and supplying the limb and the contiguous parts of the trunk.

Dissection.—The lumbar nerves and their plexus are to be seen on the left side, and to bring them into view, the dissector should scrape away the left psoas. For the most part the fleshy fibres may be removed freely ; but a small branch (accessory of the obturator) should be first looked for at the inner border of the muscle. In the substance of the quadratus lumborum a communication may be sometimes found between the last dorsal and the first lumbar nerve. The branches of the sympathetic that join the spinal nerves are to be followed along the lumbar arteries.

On the right side the psoas may be left untouched, to see the nerves issuing from it.

SPINAL LUMBAR NERVES.—The anterior primary branches of the lumbar nerves enter into the lumbar plexus with the exception of the last. Five in number, they increase in size from the first to the last, and are joined by filaments of the sympathetic near the intervertebral foramina. They supply branches to the psoas and quadratus lumborum muscles.

The fifth or lowest receives a communicating branch from the fourth nerve, and descends into the pelvis to the sacral plexus. After the two are joined, the name *lumbo-sacral* is applied to the common trunk.

The **LUMBAR PLEXUS** (fig. 91) is formed by the first four lumbar nerves. Contained in the substance of the psoas near the posterior part, the plexus consists of communicating loops between the several nerves, and increases in size from above downwards, like the individual nerves. Superiorly it is united sometimes with the last dorsal nerve ; and inferiorly it joins the sacral plexus through the large lumbo-sacral cord.

The *branches* of the plexus supply the lower part of the abdominal wall, the fore part of the thigh, and the inner side of the leg ; they are six in number, viz. :—

Dissection
of the lum-
bar plexus
on left side,

and on
right.

Four lumbar
nerves enter
the plexus,

and supply
muscles.

Fifth to the
sacral plexus
named lum-
bo-sacral.

Plexus how
formed.

Situation.

Connections
with nerves.

Six
branches,
viz. :

ilio-hypogastric

is the first branch.

Course in abdomen.

Ilio-inguinal arises with preceding,

and accompanies it.

May be absent.

The *ilio-hypogastric branch* (fig. 91, ¹) is derived from the first nerve, and appears at the outer border of the psoas muscle, near the upper part: it and the following branch are cutaneous nerves of the buttock and lower part of the trunk. The nerve is directed over the quadratus lumborum to the iliac crest, and enters the wall of the abdomen by penetrating the transversalis abdominis. Its termination in

the integuments of the buttock and abdomen, by means of an iliac and hypogastric branch, has been already mentioned (p. 479).

The *ilio-inguinal branch* (²) arises with the preceding from the first nerve, and issues from the psoas nearly at the same spot. Of smaller size than the ilio-hypogastric, this branch courses outwards over the quadratus and iliacus muscles towards the front of the crest of the hip bone, where it pierces the transversalis abdominis. The farther course of the nerve in the abdominal wall, and its distribution over the scrotum and the groin, are before noticed (pp. 479, 493).

The size of this nerve depends upon that of the ilio-hypogastric branch; and the nerve may be absent if the latter is large.

* The lumbar plexus and branches (Schmidt).—*a.* Twelfth rib. *b.* Quadratus lumborum. *c.* Cut abdominal muscles. *d.* Front of the hip bone. *e.* Adductor brevis muscle. *f.* Pectineus cut and drawn aside. *g.* Adductor longus divided. 1. Ilio-hypogastric branch. 2.

Fig. 91.*



The *genito-crural nerve* (⁷) is distributed, as the name expresses, to the genital organs and the limb. It arises from the second lumbar nerve, and from the connecting loop between the first two; it pierces the fibres of the *psoas*, and descending on the surface of the muscle divides into a genital and a crural branch. Sometimes the nerve is divided in the *psoas*, and the branches perforate separately the muscle.

Genito-crural

pierces *psoas*, and divides into

a. The *genital branch* descends on the external iliac artery, and furnishes offsets around it; it passes from the abdomen with the spermatic vessels, and is distributed in the cremaster muscle. In the female the nerve is lost in the round ligament.

genital and

b. The *crural branch* issues beneath Poupart's ligament to supply the integument of the thigh. (See Cutaneous Nerves of the Thigh.)

crural branch.

The *external cutaneous nerve* of the thigh (⁸) arises from the second nerve of the plexus, or from the loop between it and the third, and appears about the middle of the outer border of the *psoas*. The nerve then takes an oblique course across the *iliacus* to the interval between the anterior iliac spinous processes, and leaves the abdomen beneath Poupart's ligament to be distributed on the outer aspect of the limb.

Course of external cutaneous nerve

to reach the thigh.

The *anterior crural nerve* (⁴) is the largest offset of the plexus, and supplies branches to the extensor muscles of the knee joint, and the front of the thigh. Taking origin from the third and fourth nerves, and receiving a fasciculus also from the second, this large nerve appears towards the lower part of the *psoas*, and lies between that muscle and the *iliacus*. It passes from the abdomen beneath Poupart's ligament; but before its final branching in the thigh, the nerve furnishes the following twigs:—

Origin of anterior crural nerve.

Position in the abdomen; its branches

a. Some small branches are given to the *iliacus* from the outer side of the nerve.

to *iliacus*,

b. A branch to the *femoral artery*, whose place of origin varies much, is distributed around the upper part of that vessel.

to femoral artery.

The *obturator nerve* (⁶) appertains to the adductor muscles of the thigh. Derived from the third and fourth nerves in

Obturator nerve in the abdomen;

Ilio-inguinal branch. 3. External cutaneous branch. 4. Anterior crural nerve. 5. Accessory branch to the obturator. 6. Obturator nerve. 7. Genito-crural nerve—its two offsets coming separately from the plexus. 8. Lumbar part of the gangliated cord of the sympathetic nerve.

ends in the thigh ; the plexus, it is directed beneath the psoas to the inner or pelvic border ; escaped from beneath the muscle the nerve crosses the pelvic cavity below the external iliac, but above the obturator vessels, and enters the thigh through the aperture in the upper part of the thyroid foramen. Occasionally the obturator gives origin to the following branch :—

its accessory branch The *accessory obturator nerve* (^s) arises near the beginning of the trunk of the obturator, or from the third and fourth nerves of the plexus. Its course is along the inner border of the psoas beneath the investing fascia, and over the surface of the hip bone to the thigh, where it ends by joining the obturator nerve, and supplying the hip joint.

Sympathetic cord in the abdomen **GANGLIATED CORD OF THE SYMPATHETIC.**—The lumbar part of the gangliated cord of the sympathetic in the abdomen is placed on the side of the spinal column (fig. 91, ^s), and is continuous upwards beneath the inner arch of the diaphragm with the thoracic part, and downwards with the pelvic part of the same cord. It lies along the inner border

joins that in thorax ; of the psoas muscle, nearer the front of the vertebræ than the like part in the thorax, and is somewhat concealed on the right side by the vena cava. The cord presents four or five oblong ganglia opposite the bodies of the vertebræ ; and connecting branches to the spinal nerves, and visceral branches are supplied from them.

their branches to the spinal nerves *a. Connecting branches.*—From each ganglion two small branches are directed backwards, along the centre of the body of the vertebra, with the lumbar artery ; these unite with a spinal nerve near the intervertebral foramen, or they are often divided between two spinal nerves. The connecting branches are longest in the lumbar region in consequence of the cord being carried forwards by the psoas muscle to the fore part of the vertebræ.

and the supply of the viscera. *b. Branches for distribution.*—Most of the internal branches throw themselves into the aortic and hypogastric plexuses, and so reach the viscera indirectly. Some filaments enter the vertebræ and their connecting ligaments.

Last dorsal nerve. *Last dorsal nerve.*—The anterior primary branch of the last dorsal nerve resembles the other intercostal nerves in its distribution, but differs from them in not being contained in an intercostal space. Lying below the last rib, the nerve is directed outwards across the upper part of the quadratus lumborum, and beneath the fascia covering that muscle. At the outer border of the quadratus it pierces the posterior aponeurosis of the transversalis abdominis (fascia lumborum), enters the wall of the abdomen, and ends in an abdominal

Course in wall of the abdomen.

and a cutaneous branch (p. 479). Near the spine it furnishes a small branch to the quadratus muscle; and it may communicate by means of this with the first lumbar nerve. An offset from the first lumbar artery accompanies the nerve.

The LUMBAR ARTERIES are parietal branches of the aorta (p. 589), and are furnished to the spinal canal and the wall of the abdomen: they resemble the aortic intercostals in their course and distribution. Commonly four in number on each side, these arteries arise opposite the centre of the vertebræ, and the vessels of opposite sides are sometimes joined in a common trunk; they then pass backwards along the fore part of the vertebræ, beneath the pillar of the diaphragm and the psoas, to reach the intervals between the transverse processes, where each ends in an abdominal and a dorsal branch. The arteries of the right side lie beneath the vena cava.

Lumbar arteries five in number on each side.

Course and termination in

a. The *dorsal branch* continues onwards to the back between the transverse processes, and supplies an offset to the spinal canal. The distribution of the artery is described with the vessels of the back and spinal cord (pp. 432, 446).

a branch to the back,

b. The *abdominal branches* are directed outwards beneath the quadratus lumborum, the first being the largest, and enter the posterior part of the abdominal wall, where they anastomose with the lower intercostal, the circumflex iliac, and the ilio-lumbar arteries: these branches supply the psoas and quadratus muscles. The branch of the first, and sometimes of the last artery, is superficial to the quadratus; and the size of the last two varies with that of the ilio-lumbar offset of the internal iliac artery.

and a branch to the wall of the abdomen.

The LUMBAR VEINS are the same in number, and have the same course as the arteries. Commencing by the union of a dorsal and an abdominal branch at the root of the transverse process, the trunk of the vein is directed forwards with the artery to the vena cava. They open into the posterior part of the cava, either singly, or conjointly with those of the opposite side. On the left side the veins are longer than on the right, and pass beneath the aorta.

The veins resemble the arteries,

and open into the cava; left longest.

Around the transverse processes, and beneath the psoas muscle, the lumbar veins communicate freely with one another, with the ilio-lumbar, and sometimes with the common iliac, so as to form a plexus of veins. Issuing from the plexus on each side is a venous trunk, the *ascending lumbar vein*, which joins the azygos vein of the corresponding half of the body.

A plexus around the transverse processes.

CAVITY OF THE PELVIS.

Definition of and situation. The cavity of the pelvis is but a part of the general abdominal space (p. 512), and is situate below the brim or inlet of the true pelvis.

Boundaries. *Boundaries.*—The space is surrounded by the firm bony ring of the pelvic bones, and therefore admits of little alteration in its form or capacity. Behind it is bounded by the sacrum and the coccyx with the sacro-sciatic ligaments. And laterally and in front, by the innominate bones covered by the obturator muscles. Inferiorly, or towards the perinæum, the cavity is limited by the fascia reflected from the wall to the viscera, and by the levatores ani and coccygei muscles: only in this last direction, where the bounding structures are moveable, can alterations be made in the capacity of the space.

Contents. *Contents.*—In the interior are contained the urinary bladder, the lower end of the large intestine or the rectum, and some of the generative organs according to the sex. All the organs have vessels, nerves, and lymphatics distributed to them, and the serous membrane is reflected over them.

SECTION I.

FASCIA OF THE PELVIS AND MUSCLES OF THE OUTLET.

Outline of the fascia of the pelvis. On the wall of the pelvis is a thin fascia (pelvic), which extends from the brim to the outlet, and covers the obturator muscle. At a certain level a visceral portion is directed inwards from it to the rectum and the bladder; and this is named recto-vesical fascia from the viscera with which it is connected.

Steps to define the pelvic fascia. *Dissection.*—To bring into view the parietal part, or the pelvic fascia, the external iliac vessels, and the psoas (if this has not been removed in the dissection of the lumbar plexus), are to be taken away on the left side of the body. The

obturator vessels and nerve are to be cut away on the same side; and the peritoneum being detached from the wall of the pelvis, the fascia will be seen on scraping away with the handle of the scalpel a large quantity of fat.

But the membrane is now apparent only in its upper half, or as low as the situation of the piece that is prolonged inwards to the viscera;—to see its lower half, the student must raise the outlet of the pelvis and look to the fascia covering the outer wall of the ischio-rectal fossa. Should the perinæum be undissected, the fat must be taken from the hollow referred to. If the scalpel be pushed upwards in the fossa, it will enter the pelvis where the visceral joins the parietal piece, and will mark the position of the levator ani muscle between the two.

The PELVIC FASCIA is a thin membrane in close contact with the obturator muscle, and is fixed to the bone around the attachment of the fleshy fibres, so that it might be called the special fascia (obturator) of that muscle. Above it reaches the brim of the pelvis for a short distance at the lateral aspect of the cavity; in front of that spot it does not extend so high as the brim, but following the muscle forms an arch below the obturator vessels; whilst farther to the middle line it is fixed along an oblique line near the lower part of the symphysis pubis. Inferiorly the fascia is attached to the margin of the great sacro-sciatic ligament, and to the side of the pubic arch; but below the pubes it is continued from the one hip bone to the other, so as to close the front of the cavity of the pelvis for a short distance.

At a certain level, viz., that of a line prolonged from the lower part of the symphysis pubis to the ischial spine, the fascia sends inwards the recto-vesical piece to the viscera of the pelvis. The origin of this offset is indicated by a whitish band, which marks also the attachment of the levator ani muscle beneath.

The outer surface of the pelvic fascia is in contact with the obturator muscle. The inner surface, above the origin of the recto-vesical piece, corresponds with the cavity of the pelvis, but below that line, with the ischio-rectal fossa. At the posterior border of the obturator muscle a thin membrane is continued backwards to the front of the sacrum, over the sacral plexus and the pyriformis muscle, but beneath the iliac vessels, by branches of which it is perforated.

The term "pelvic" is not always applied, as in the previous description, to the fascia in its whole extent from

In the pelvis,

and the perinæum.

Fascia of the wall of the pelvis.

Its attachment around the obturator muscle;

partly closes aperture of pelvis in front;

gives off recto-vesical piece.

Connections of the fascia.

Different terms ap-

plied to the fascia.

the brim to the outlet of the pelvis, but the name "obturator" is given to the half of it below the recto-vesical piece. Those who make this distinction describe the pelvic fascia as dividing into obturator and recto-vesical layers at the level of the line mentioned.

Recto-vesical layer after.

The *recto-vesical fascia* may be now seen in part; but it will be better displayed after the hip bone has been taken away for the purpose of giving a side view of the pelvis.

How to remove the innominate bone.

Dissection.—To obtain a side view of the pelvis it will be necessary to detach one innominate bone, say the left. The pelvic fascia is first to be separated from the bone and the obturator muscle, but without destroying before and behind the attachments of the white band of the fascia. The innominate bone is then to be sawn through in front rather external to the symphysis; and the lateral articulation with the sacrum is likewise to be sawn through. After the innominate bone has been somewhat separated from the rest of the pelvis, the ischial spine with the pelvic fascia attached to it may be cut off with a bone forceps; and the rest of the bone may be removed by cutting through the pyriformis muscle, the vessels and nerves passing through the sacro-sciatic notch, and any other structure that may retain it.

Preparation of the parts.

A small block is afterwards to be placed beneath the pelvis. The bladder is to be moderately distended with air. Some tow is to be introduced into the rectum, also into the vagina if it is a female pelvis; and a small piece is to be placed in the pouch of the peritoneum between the bladder and the rectum. After the viscera are thus made prominent, the recto-vesical fascia and the ischial spine should be raised with hooks whilst the levator ani and coccygeus muscles are cleaned.

Outlet of pelvis is closed by

pyriformis, by coccygeus, and sacro-sciatic ligaments,

with vessels and nerves;

by levator ani,

Parts closing the outlet of the pelvis.—In addition to the recto-vesical fascia, the following parts fill the large outlet of the dried pelvis. Beginning behind, the student will meet first with the pyriformis passing through the great sacro-sciatic notch, with the gluteal vessels and nerve above it. Next comes the coccygeus muscle, with the small sacro-sciatic ligament stretched between the ischial spine and the coccyx, one border of the muscle reaching towards the pyriformis, and the other to the levator ani; and between the posterior border and the pyriformis will be the sacral plexus of nerves, and the sciatic and pudic vessels. The greater part of the rest of the space is closed by the levator ani, which extends forwards from the coccygeus to the posterior

part of the symphysis pubis : it meets its fellow inferiorly ; and by pelvic fascia below the pubes. but, in front, the muscles of opposite sides are separated by the urethra and the prostate gland, and the interval between them is closed by the fascia lining the pelvis.

The COCCYGEUS MUSCLE is flat and triangular, and assists to close the outlet of the pelvis. It arises by a narrow process from the upper part of the ischial spine, and some fibres are attached to the small sacro-sciatic ligament. Widening as it passes inwards the muscle is inserted into the side and anterior surface of the coccyx, and into the side of the lower piece of the sacrum. The inner surface looks to the pelvis, and is in contact with the rectum on the left side ; the opposite surface rests on the small sacro-sciatic ligament. The hinder border is contiguous to the pyriformis muscle, only vessels and nerves intervening ; and the anterior or lower border is parallel with the levator ani muscle.

The LEVATOR ANI is a thin flat muscle, which is attached above to the side of the pelvis, and descends below into the outlet of the cavity, where it joins its fellow and supports the viscera. It arises anteriorly by fleshy fibres from an oblique line on the posterior aspect of the pubes, and posteriorly from the inner surface of the ischial spine ; and between those two points of bone the muscle takes origin from the under part of the recto-vesical fascia, along the line of the white band before alluded to (p. 603). All the fibres are directed downwards to the middle line of the body, to be inserted after the following manner :—The anterior, the longest, descend by the side of the prostate and join, in front of the rectum, with the muscle of the opposite side in the central point of the perinæum ; the middle fibres blend with the side of the rectum ; whilst the posterior meet the opposite muscle behind the gut, and are attached in part to the side of the coccyx, as before described in the dissection of the perinæum (p. 458).

The anterior fibres of the levator are in contact with the fascia that closes the pelvic cavity below the pubes ; and the posterior are parallel to the coccygeus muscle. The upper surface is contiguous to the recto-vesical fascia and the viscera of the pelvis ; and the under surface looks to the perinæum (ischio-rectal fossa). The two muscles, by their union, form a fleshy layer or diaphragm across the outlet of the pelvis, similar to that which separates the abdomen from the chest : this partition is convex below and concave above, and gives passage to the rectum. In front there is an interval between the anterior fibres, which allows the

Coccygeus ;
origin

and inser-
tion.

Connections
of surfaces

and borders.

Levator
ani ;

situation.

Origin
partly from
bone, and
partly from
membrane.

Insertion
along mid-
dle line of
the perinæ-
um.

Borders and
surfaces.

Two mus-
cles form a
fleshy dia-
phragm.

Anterior
fibres named
levator pros-
tatae.

urethra, together with the vagina in the female, to pass from the pelvis.

The anterior part of the muscle which descends by the side of the prostate, and unites with its fellow below the membranous part of the urethra, thus supporting that canal as in a sling, is named sometimes *levator seu compressor prostatae*.

Dissection
for the rec-
to-vesical
fascia.

Dissection.—The recto-vesical fascia will be seen by detaching the fleshy fibres of the levator ani at their origin, and the coccygeus muscle from the ischial spine, and throwing both downwards. Below the level at which the fascia reaches the side of the prostate gland and the rectum, it gives sheaths to those viscera; and to demonstrate these sheaths one incision is to be made along the prostate, and another along the lower end of the rectum, below the attachment of the fascia.

Recto-vesi-
cal fascia

The *recto-vesical fascia* is derived from the pelvic fascia, and supports and partly invests the viscera of the pelvis.

arises from
pelvic fascia,

Arising, as before said, on a level with the band that extends from the pubes to the ischial spine, the fascia is directed inwards on the levator ani, and has the following disposition on the viscera:—In the middle line in front it is continued from the back of the pubes to the upper surface of the prostate; here it closes the pelvis before the levatores ani, and forms on each side of the middle line a roundish band, the anterior ligament of the bladder. More to the side the fascia is attached to the lateral part of the prostate and bladder, giving rise to the lateral vesical ligament. And still farther back it reaches the side of the rectum.

It gives
sheaths to
the prostate
and rectum,

The fascia does not cease, where it meets the viscera, by becoming blended with each, but is continued downwards around the prostate and the rectum, so as to form sheaths for those viscera below the level of its attachment to them. The sheath that is prolonged on the gut becomes thin towards the anus; whilst that on the prostate is separated from its viscus by a plexus of veins (prostatic), and an offset is directed backwards from it to incase the vesiculæ seminales.

and forms
part of the
floor of the
pelvis.

The recto-vesical fascia forms a partition, like that of the levatores ani muscles, across the pelvis, which is perforated by the prostate and the rectum; but in the case of the fascia the viscera receive sheaths as they pass through it.

Fascia in
the female,

In the female the fascia has much the same arrangement as in the male; but the vagina, instead of the prostate, perforates the membrane, and receives a tube from it.

The *true ligaments of the bladder* are two on each side, anterior and lateral, and are derived from the recto-vesical fascia. Pieces of the fascia

The *anterior* reaches from the posterior part of the pubes to the upper surface of the prostate, and the neck of the bladder; it is a narrow white band, and encloses some muscular fibres of the bladder. Between the ligaments of opposite sides, the recto-vesical fascia dips down to reach the apex of the prostate. form the anterior ligaments,

The *lateral ligament* is a piece of the same fascia, which is fixed to the lateral part of the prostate gland, at the upper border, and to the side of the bladder on the same level. and lateral of the bladder.

There are other ligaments of the bladder (*false ligaments*), which are derived from the peritoneum investing it, and will be described in the following section. False ligaments of bladder.

SECTION II.

CONNECTIONS OF THE VISCERA IN THE MALE.

Directions.—If the student should be dissecting a female pelvis, he will find the description of it at page 615.

Contents and position.—The viscera in the cavity of the male pelvis are the lower end of the large intestine (rectum); the bladder with its excretory tube—the urethra; together with some generative organs, viz. the seminal canals and vesicles. These have the following relative situation:— Contents of the pelvis.

The rectum is behind all, and takes a curved course, with the convexity backwards, along the front of the sacrum and the coccyx. The bladder is placed in the concavity of the rectum, its neck being surrounded by the prostate gland; and the urethra curves forwards from it above the tube of the intestine. Beneath the bladder—between it and the rectum—are the little seminal sacs with the vasa deferentia. Some of these organs are partly surrounded by the peritoneum. Outline of their position.

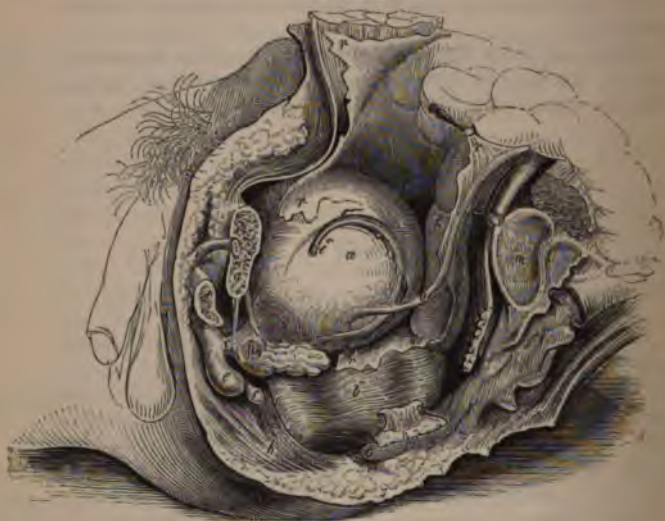
Dissection.—All the recto-vesical fascia, except the anterior ligament of the bladder (fig. 92, ⁶) may be taken from the viscera. The obliterated remnant of the internal iliac artery (hypogastric) should be next followed forwards along the bladder from the back of the pelvis; but the other Take away fascia and some vessels.

branches of the same artery to the lower limb are to be cut off. When the fat and the vessels have been cleared away, the pouch of the peritoneum, in which wool has been placed, will be brought into view, with the ureter passing to the bladder.

The several
viscera are
to be
cleaned.

The prostate may be now cleaned, and the vesiculæ seminales which are behind it should be defined. The part of the bladder below the peritoneum is likewise to be prepared; and at the same time the vas deferens, which lies on the

Fig. 92.*



lateral aspect of the viscus, is to be followed down to its seminal sac. Lastly, the layer of fascia is to be removed from the part of the rectum below the peritoneum, but the branches to the gut from the inferior mesenteric artery are to be preserved. If the bladder has become flaccid, half fill it with air, in order that its connections may be studied.

* Side view of the male pelvis (altered from Quain's Arteries).—*b*, Rectum. *a*, Bladder. *u*, Ureter; and *t*, Anterior ligament. *p*, Prostate. *c*, Membranous part of the urethra. *e*, Bulb of the urethra. *d*, Crus penis cut. *v*, Vesicula seminalis (left). *i*, Vas deferens of the same side (cut). *f*, Cowper's gland. *n*, Ischial spine of the left hip bone sawn off with the sacro-sciatic ligament. *r*, Pelvic part of the peritoneum. *r'*, Recto-vesical pouch.

The *peritoneum* does not envelop the viscera of the pelvis so completely as those of the upper part of the abdomen. After partly surrounding the upper portion of the rectum, and fixing it by a process—*meso-rectum*, the membrane can be traced to the back of the bladder, where it projects for some way between this viscus and the rectum, forming the recto-vesical pouch. On each side of the rectum the serous membrane is arrested by the internal iliac artery, and gives rise to a fold, the posterior ligament of the bladder. Tracing the peritoneum upwards on the bladder, the student will find it covering all the posterior surface; and covering the posterior part of each lateral region as far forwards as the position of the obliterated hypogastric artery, but at that vessel it is reflected from the sides and summit of the bladder to the wall of the pelvis and abdomen. All the anterior surface of the bladder is therefore uncovered by peritoneum; and when the bladder is distended it rises above the pubes so as to allow of its being punctured in front without injury to the serous membrane.

The peritoneum

covers partly the rectum;

and partly the bladder,

leaving front and lower part uncovered.

The *recto-vesical pouch* (fig. 92, *r'*) is wide behind, where it corresponds with the interval between the iliac arteries, and is narrow in front between the rectum and the bladder. Anteriorly it extends as far as, or even into the interval between the *vesiculæ seminales*; it ends usually about one inch and a half from the tip of the coccyx, but sometimes it reaches the prostate gland. The distance of the pouch from the anus is commonly about four inches; but it will vary with the state of the bladder, for if this viscus is distended the peritoneum will be raised with it, and removed farther from the end of the intestine.

Pouch between the rectum and bladder.

Extent forwards and distance from the anus vary.

False ligaments of the bladder.—Where the peritoneum is reflected from the bladder to the wall of the cavity, it gives rise to the false ligaments of that viscus. These are five in number:—two posterior, two lateral, and one superior.

False ligaments of the bladder viz.,—

The *posterior ligament* (one on each side) reaches from the back of the pelvis to the bladder, and contains the obliterated hypogastric artery, the ureter, and some vessels and nerves. Between these is the hollow of the recto-vesical pouch.

two posterior,

The *lateral ligament*, also one on a side, is a wide piece of peritoneum, which is reflected from the side of the bladder to the iliac fossa and the wall of the pelvis. Along its line of attachment to the bladder is the obliterated hypogastric artery.

two lateral,

The *superior ligament* is reflected from the upper part of

R R

- and one superior. the bladder, along the remains of the obliterated hypogastric vessel to the abdominal wall.
- Extent of the rectum, The RECTUM, or the lower part of the great intestine, extends from the articulation between the sacrum and the left hip bone to the anus, and is kept in place by the peritoneum and the recto-vesical fascia. The intestine is about eight inches length, and has a winding course, for it follows the curve of the sacrum and coccyx : it is divided into three parts—upper, and divisions, middle, and lower.
- First piece The *upper part*, longer than the others, extends obliquely from the sacro-iliac articulation to the centre of the third piece of the sacrum. It is surrounded almost entirely by the peritoneum which forms the meso-rectum behind it : it most covered by peritoneum, lies against the sacrum, and on the pyriformis muscle and the sacral plexus of the left side. In contact with its left side are the branches of the internal iliac artery, and the left ureter. In some bodies this part of the intestine is much curved to the right side.*
- Middle piece The *middle piece* lies beneath the bladder, and reaches to the tip of the coccyx : it is about three inches in length, and is covered by peritoneum on the upper aspect for about one third of its extent. Resting on it is the lower or triangular part of the bladder, with the vesiculae seminales and vasa deferentia ; and behind it are the sacrum and coccyx. On only covered in front, the left side is the coccygeus muscle.
- Last piece is uncovered. The *lower part* is about an inch and a half in length, and is curved from the tip of the coccyx to the anus : at first it is much dilated, but at the anus it is contracted. This end of the intestine is without peritoneal covering, and is supported by the lower part of the triangular ligament of the urethra, and by the levatores ani muscles. Above the extremity of the rectum (in this position of the body) are the prostate, the membranous part of the urethra, and the bulb of the corpus spongiosum urethrae ; but as the gut recedes gradually from the urethra there is an angular interval left between the two. The levatores ani muscles descend on its sides, and unite beneath it, supporting it in a sling ; and the sphincter muscles surround the aperture. Sometimes this end
- Connections with parts around.

* In the dissecting-room of the College in one Winter (1854—1855) I saw three examples of the rectum being placed on the right side of the sacrum. In two bodies the lower end of the left colon crossed the spine, at the top of the sacrum, and the rectum descended through the pelvis, on the right of the middle line, to the end of the coccyx. In the third it crossed the spine twice, once at the top of the sacrum, and again about the middle of that bone.

of the intestine is very much enlarged, especially in women and old men ; and in that condition it rises up on each side, and surrounds in the male the prostate, except above.

Sometimes dilated.

The URINARY BLADDER (*vesica urinaria*) is situate in the pelvis (fig. 92, *a*), and is the receptacle for the fluid secreted by the kidneys. When the bladder is contracted it is of a triangular form, and lies within the pelvis against the anterior wall of the cavity. But when distended it becomes of a conical shape, with the larger part directed towards the rectum, and the apex to the abdominal wall ; and it is slightly curved over the anterior part of the pelvis as it projects beyond the bone. If a line through its centre were prolonged, it would touch the abdominal wall somewhere (according to the distension) between the umbilicus and the pubes in the one direction, and the end of the coccyx in the other direction. The organ is maintained in its position by the recto-vesical fascia and the peritoneum, which form its ligaments (pp. 607, 609).

Bladder is in pelvis when empty,

and projects above when full.

Axis.

For the purpose of studying its connections the bladder is divided into the following parts :—a summit and base, and a body and neck.

Divisions.

The *summit* or apex of the bladder is rounded, and from its anterior part three ligamentous cords are prolonged to the umbilicus ; the central one of these is the remnant of the urachus ; and the two lateral are formed by the obliterated hypogastric arteries. If the bladder is full the apex is above, but otherwise below the pubes. All the surface behind the obliterated vessels is covered by peritoneum.

Apex has cords on it.

The *base* (*fundus*) is large, and rests on the middle piece of the rectum. In the state of emptiness of the bladder the base is scarcely prominent ; but in distension of the viscus, this part extends lower, and becomes widened. Connected with the under part of the bladder are the *vesiculae seminales* and the *vasa deferentia* ; and between these is a triangular space, from which the peritoneum is absent.

Base

alters in shape ;

parts in contact with it.

Surfaces of the body.—The anterior part of the bladder is in contact with the posterior surface of the symphysis pubis, and with the lower part of the abdominal wall if it is distended, and is altogether free from peritoneum ; whilst the posterior surface is entirely covered by the serous membrane.

Surfaces ; anterior

and posterior.

Extending along the upper part of each lateral region is the obliterated hypogastric vessel, and crossing it lower down is the *vas deferens* ; near the under part is the entrance of the ureter into the bladder. All the side of

Lateral surface.

the bladder behind the hypogastric vessel is covered by peritoneum, but the rest is uncovered.

Neck. The *neck* (cervix) is the narrow anterior part of the bladder that joins the urethra. It is surrounded by the prostate gland.

Position in pelvis varies with age. The position of the bladder in the pelvis is not the same in adult as in early life. For in the child this viscus rises above the brim of the pelvis into the hypogastric region of the abdomen, and the cervix is the lowest part. But in the adult the bladder is contained within the space enclosed by the larger pelvic bones, and the base or fundus projects inferiorly.

Ureter in pelvis, The *ureter* enters the posterior ligament of the bladder, after crossing the common or the external iliac artery, and forms an arch below the level of the obliterated hypogastric vessel; it reaches forwards to enter the bladder near the lower part, and somewhat on the side, at the distance of about two inches from the prostate gland.

Position of the prostate; The PROSTATE GLAND (fig. 92, *p*) surrounds the neck of the bladder. It is placed below the level of the symphysis pubis, as well as posterior to it, and is supported by the rectum. Its shape is conical with the base turned backwards, and its size equals nearly that of a large horse chesnut. In the present position of the pelvis, a line from the apex through the middle of the gland would be directed obliquely backwards, though, in the erect state of the body, it would have an opposite direction.

Upper surface; The *upper surface* is about three quarters of an inch below the symphysis pubis, and is connected to it by the anterior ligaments of the bladder. On this surface are branches of the dorsal vein of the penis.

under surface. The *under surface* has the greatest extent, and is contiguous to the rectum; this is the part that is felt by the finger introduced into the bowel through the anus.

Apex and base. The *apex* touches the fascia of the pelvis that closes the upper part of the subpubic arch; and the base surrounds the vesiculæ seminales with the vasa deferentia, and limits anteriorly with them the triangular space at the base of the bladder.

It is contained in a sheath; The prostate is enveloped by a sheath obtained from the recto-vesical fascia (p. 606), and a plexus of veins (prostatic) surrounds it. Through the middle of the gland the urethra takes its course to the penis. The size of the prostate alters much with increasing age, and in old people it may acquire a considerable magnitude.

size may increase.

The **vesiculæ seminales** (fig. 92, *v*) are two small sacculated bodies, each about two inches long, between the under part of the bladder and the rectum. Each is pyramidal in form, and has the larger end turned backwards towards the ureter, whilst the smaller is surrounded by the prostate. Along the inner side is the vas deferens. At the prostate gland the vesiculæ approach one another, only the vasa deferentia intervening; but farther backwards they diverge, and enclose with the pouch of the peritoneum a triangular space at the under aspect of the bladder. The vesiculæ are contained in a membranous sheath, which is derived from the recto-vesical fascia.

The **vas deferens** or the excretory duct of the testis (fig. 92, *i*) in its course to the urethra enters the abdomen by the internal abdominal ring, and is directed inwards along the side and under part of the bladder to the base of the prostate, where it forms the common ejaculatory duct by joining with the duct from the vesicula seminalis. The position of this tube to the external iliac artery has been noticed; on the bladder it may be seen to cross the obliterated hypogastric artery, and to pass internal to the ureter and the vesicula of the same side. By the side of the vesicula the duct is much enlarged, and is sacculated.

The **urethra** is the excretory passage for the urine and semen (fig. 92), and reaches from the bladder to the end of the penis. Its length varies from eight to nine inches and a half, and it presents one or two curves according to the state of the penis. At first the canal is directed forwards and upwards through the triangular ligament of the perineum, to the body of the penis, forming a large curve with the concavity to the pubes. Thence to its termination the urethra is applied to the penis; and whilst this body remains pendent it forms a second bend with the concavity downwards, but if the penis is raised, the canal makes but one curve throughout. The canal is divided into three parts, prostatic, membranous, and spongy.

The **prostatic part** (fig. 92, *p*) is contained in the prostate gland, and receives its name from that circumstance. Its length is about one inch and a quarter; and its connections are the same as those of the gland (p. 612).

The **membranous part** (fig. 92, *c*) is nearly an inch long, and intervenes between the apex of the prostate and the front of the perineal triangular ligament. It is somewhat curved upwards, but as the bulb of the next portion of the urethral tube is directed backwards below it, the under part

Seminal
vesicles;
their con-
nections.

Vas
deferens;
course;

unites with
duct from
vesicula.

The
urethra;
length;
curved
according to
the con-
dition of
the penis;

its division.

Prostatic.

Membra-
nous.

Connections. appears to measure less than the upper. Surrounding it are the muscular fibres of the constrictor urethræ; and close below it are Cowper's glands with the rectum. This division of the urethra is the weakest; but it is supported by the triangular ligament.

Spongy. The *spongy part* is so named from its being surrounded by a cellular and vascular structure. It is applied to and assists to form the body of the penis, and terminates anteriorly in the orifice named meatus urinarius in the end of the glans. It is the longest part of the urethra, and measures about six inches. At its commencement this division of the excretory canal is surrounded by the ejaculator urinæ muscle.

Dissection. *Dissection.*—All the tegumentary covering of the penis may be removed, to see the component parts of that body; and after its removal the spongy part of the urethra will be better seen.

Constituents and situation of the penis. The PENIS is a cylindrical body, which is attached to the fore part of the pelvis, and hangs in front of the scrotum. It is constructed of two firm fibrous bodies named corpora cavernosa, which form the principal part of the organ; and below these is a soft spongy substance (*corpus spongiosum*) which surrounds the urethra, and forms the head or the glans penis. A tegumentary investment covers the whole, and is supplied with vessels and nerves; it is noticed at p. 480.

Corpora cavernosa form body of penis, The *corpora cavernosa* form the bulk of the penis, and are two dense, fibrous, almost cylindrical tubes, which are filled with a vascular texture. Each is fixed posteriorly to the upper part of the pubic arch for about an inch by a thick pointed process, the *crus penis* (fig. 92, *d*); and after a distance of an inch and a half it is blended with its fellow in the body of the penis. Near its junction with its fellow there is a slight swelling on the crus—the bulb of the corpus cavernosum (Kobelt).

but each is separate behind. The *body* of the penis, formed by the union of the corpora cavernosa, is grooved above and below along the middle line, and presents anteriorly a narrowed but truncated extremity that is covered by the glans penis; along its under surface the urethra is conducted. Besides the attachment of the corpora cavernosa by the crura, the body of the penis is connected with the front of the symphysis pubis by the suspensory ligament.

Form and attachment of penis. The *corpus spongiosum urethræ* encloses the urethral canal, and forms the head of the penis. It is a vascular and

erectile texture, like the corpora cavernosa, but is much less strong. Commencing posteriorly by a dilated part—the bulb, it extends forwards around the urethra to the extremity of the penis, where it swells out into the conical glans penis. Corpus spongiosum surrounds urethra, and swells into the bulb.

a. The *bulb* (fig. 92, *e*) lies in front of the triangular ligament of the urethra, and opposite the point of junction of the crura of the corpora cavernosa. It is directed backwards slightly below the membranous part of the urethra, and is fixed by fibrous tissue to the front of the triangular ligament. The accelerator urinæ muscle covers it. This enlargement presents usually a central depression, with a bulging on each side, and is subdivided into two lobes. which is lobed;

b. The *glans penis* is somewhat conical in form, and covers the truncated end of the corpora cavernosa. Its base is directed backwards, and is marked by a slightly prominent border—the *corona glandis*; it is also sloped obliquely along the under aspect, from the apex to the base. In the apex is a vertical slit, in which the urethral canal terminates; and below that aperture is an excavation which contains the *frænum preputii*. and the conical glans penis.

SECTION III.

CONNECTIONS OF THE VISCERA IN THE FEMALE.

In the pelvis of the female are contained the lower end of the intestinal tube, and the bladder and the urethra, as in the male; but there are in addition the generative organs, viz., the uterus with its accessories, and the vagina. Contents of the female pelvis,

Position.—The rectum is posterior to the rest as in the male pelvis, and forms a like curve. In the concavity of the bent intestine lie the uterus with its appendages, and the tube of the vagina. And in front of all are the bladder and the urethral canal. In this sex there are three tubes connected with the viscera, and all are directed forwards, one above another, to the surface, viz., the tube of the urethra, that of the vagina, and that of the rectum. and their situation.

Directions.—The description in Section I. (p. 602) must be used for instructions respecting the removal of the innominate bone, and for the anatomy of the fasciæ, and the muscles of the outlet of the pelvis. Use description of male pelvis.

After the student has learnt, as directed above, the fasciæ and the muscles, which are nearly alike in both sexes, he may make the following special dissection of the viscera of the female pelvis.

Then clean
the viscera
of the female
pelvis.

Dissection.—On taking away the recto-vesical fascia and much fat, the several viscera will come into view. To maintain the position of the uterus, raise it up with a piece of string passed through the upper part. The reflections of the peritoneum on the viscera are to be preserved; and a piece of cotton wool is to be placed between the rectum and the uterus.

Dissect ves-
sels.

The obliterated part of the internal iliac artery is to be followed forwards to the bladder, but all the other branches may be cut away on this the left side. The ureter will be found passing to the bladder close to that artery.

Isolate
viscera.

Afterwards the urethra, the vagina, and the rectum are to be cleaned and partly separated from one another at the anterior part of the pelvis, but the arteries on the rectum are to be preserved.

Reflections
of the peri-
toneum.

The *peritoneum* gives a partial covering to the viscera, as in the male pelvis. Investing the upper part of the rectum, and forming behind it the meso-rectum, the membrane is continued for a short distance on the front of the intestine to the posterior part of the vagina, and the back of the uterus. It covers the posterior, and the greater part of the anterior surface of the uterus, and can be traced to the bladder without again touching the vagina. On each side of the uterus it forms a wide fold (broad ligament), which attaches that viscus to the wall of the abdomen and pelvis. As the peritoneum is followed upwards to the wall of the abdomen, it will be found to cover the posterior surface of the bladder, and the lateral part behind the position of the obliterated hypogastric artery. In the female the pouch between the rectum and bladder can be scarcely said to exist, because the vagina intervenes between the two, and arrests, so to express it, the passing forwards of the peritoneum. In the pelvis the serous membrane forms the following ligaments for the uterus and bladder.

Folds or
ligaments
are—

Broad lig-
ament of the
uterus,

which is
sub-divided
into three
parts.

The *broad ligament of the uterus* passes from the side of the uterus to the wall of the abdomen, and supports that organ in the cavity of the pelvis. By its position across the pelvis, it divides the cavity into an anterior and a posterior part: in the former are placed the bladder, urethra, and vagina; in the latter the upper part of the rectum, and the small intestine when it reaches the pelvis. Each ligament

shows traces of a subdivision into three pieces, corresponding with the bodies contained between its two layers. Thus there is a posterior piece belonging to the ovary and its ligament; an anterior, near the upper part, which is appropriated to the round ligament; and a middle piece, the highest of all, surrounds the Fallopian tube. It is at the free extremity of the Fallopian tube that the peritoneum is continuous with a mucous membrane.

Anterior and posterior ligaments of the uterus.—As the peritoneum is reflected from the rectum to the uterus, and from the uterus to the bladder, it forms two anterior and two posterior folds or ligaments, one on each side. The anterior, or *vesico-uterine* pair is smaller than the posterior or *recto-uterine*. Anterior and posterior of uterus.

The *false ligaments of the bladder* are the same as in the male, and are five in number, viz., two posterior, two lateral, and a superior: they are all blended in one large piece of peritoneum that reaches from the bladder to the side and the front of the pelvis. In the female the posterior ligament, containing the ureter and the vessels of the bladder, is less marked than in the male, because the uterus intervenes and pushes aside the vessels. Five ligaments of the bladder.

The RECTUM is not so curved in the female as in the male, and is generally larger. Descending along the middle of the sacrum and coccyx to the anus, the intestine is divided into three parts:— Connections of the rectum, viz.,

The *first part* extends to the third piece of the sacrum, and is enveloped by the peritoneum, except posteriorly: its connections are similar to those of the rectum in the male. of upper,

The *middle part* reaches to the tip of the coccyx, and has the vagina above and in contact with it. The peritoneum touches the front for a very short distance, if at all. middle,

The *lower part* curves to the anus away from the vagina so as to leave between the two, a space which corresponds, on the surface of the body, with the part of the perinæum between the anus and the vulva. The levatores ani are on the sides, and unite below it, and the sphincter muscles surround the extremity. and lower part.

The UTERUS is somewhat conical in shape, and is flattened from before backwards. Situate in the pelvis between the bladder and the rectum, it is retained in place by the broad and other ligaments. Its wider end is free and placed upwards, and the lower end communicates with the vagina. Unless enlarged, it lies below the brim of the pelvis. This viscus is tilted forwards, so that its position is oblique in the Uterus; form and situation.
Position to the brim of pelvis.

- cavity of the pelvis ; and a line through the centre of the organ would correspond with the axis of the inlet of the pelvic cavity, but not with that of the vagina.
- Axis.** The *anterior surface* is covered by peritoneum, except in the lower fourth where it is in contact with the bladder. The *posterior surface* is invested altogether by the serous membrane.
- Surfaces.** The *upper end* (fundus vel basis uteri) is the largest part of the organ, and is in contact with the small intestine. The *lower end*, or the neck (cervix uteri) is received into the vagina.
- Extremities.** To each *side* are attached the broad ligament with the Fallopian tube, the round ligament, and the ovary.
- On the side are** *a.* The *Fallopian tube* is contained in the upper or free border of the ligament ; one end is connected to the upper angle of the uterus, whilst the other is loose in the cavity of the pelvis. At its attachment to the uterus the tube is of small size, but at the opposite extremity it is dilated, like the end of a trumpet, and fringed, forming the corpus fimbriatum.
- Fallopian tube,** *b.* The *round* or suspensory *ligament* is a fibrous cord, which is directed outwards through the internal abdominal ring and the inguinal canal to the groin. This cord lies over the obliterated hypogastric, and the external iliac artery ; and it is surrounded by the peritoneum, which accompanies it a short way into the canal.
- round ligament,** *c.* The *ovary* is placed nearly horizontally, and bulges at the posterior aspect of the broad ligament ; it is connected to the uterus at the inner end by a special fibrous band, *ligament* of the ovary. Its form is oval, and its margins are turned forwards and backwards. Its size is very variable.
- and the ovary and its ligament.** The VAGINA is the tube by which the uterus communicates with the exterior of the body. It is somewhat cylindrical in shape, though flattened on the front and back ; and its length is about five inches. The vagina is slightly curved as it follows the bend of the rectum, and its axis therefore corresponds at first with the centre of the outlet, but higher up with that of the cavity of the pelvis. In front the vagina is in contact with the base of the bladder, and the urethra ; and beneath or below it is the rectum. To the side is attached the recto-vesical fascia, which sends a sheath along the lower half of the tube. The upper end receives the neck of the uterus by an aperture in the anterior or upper wall ; and the lower end is the narrowest part of the canal, and is surrounded by the sphincter vaginae muscle. In children,
- Vagina : extent and form ;**
- length ;**
- axis.**
- Connections.**

and in the virgin state of the part, the external aperture is closed by the hymen. The vagina is surrounded by a large plexus of veins. Lower end partly closed.

The **BLADDER** is placed at the anterior part of the pelvis, above the vagina and in contact with the back of the pubes. Its form, position, and connections so closely resemble those of the bladder in the male body, as to render unnecessary any repetition (see p. 611). The chief differences in the bladder of the two sexes are the following :— Bladder resembles that of the male.

In the female the bladder is larger than in the male, and its transverse exceeds its vertical measurement. The base is of less extent; it is in contact with the vagina and the lower part of the uterus; and it does not project below the level of the urethra, so as to form a pouch as in the male. On the side of the viscus there is not any vas deferens; and the prostate does not project around the neck. Differences in the two sexes.

The *ureter* has a longer course in the pelvis of the female than in that of the male before it reaches the bladder. After crossing the internal iliac vessels, it passes by the neck of the uterus ere it arrives at its destination. Course of ureter.

The *urethra* is a small narrow tube about one inch and a half long, which curves slightly below the symphysis pubis, the concavity being upwards. Its situation is above the vagina, and its external opening is placed within the vulva. In its course to the surface it is imbedded in the tissue of the vaginal wall, and perforates the triangular ligament of the perinæum; but it is surrounded by the muscular fibres of the constrictor and orbicularis urethræ (p. 474). A plexus of veins surrounds the urethra as well as the vagina. Urethra; length and form; connections with parts around.

SECTION IV.

VESSELS AND NERVES OF THE PELVIS.

This section is to be used by the dissectors of both the male and female pelvis.

In the pelvis are the internal iliac vessels, and their branches to the viscera; the sacral plexus and its nerves; and the sympathetic nerve, consisting of both a gangliated cord and offsets of the hypogastric plexus. Vessels and nerves of the pelvis.

Directions.—The internal iliac vessels are to be dissected on the right side. But the air should be previously let out

- of the bladder, and this viscus and the rectum, together with the uterus and the vagina in the female, should be drawn from their situation in the centre of the pelvis.
- To dissect the vessels of the pelvis. *Dissection.*—The peritoneum and the loose tissue and fat are to be removed from the viscera and the trunks of the vessels, as well as from the branches of the artery that leave the pelvis or supply the viscera; and the obliterated cord of the hypogastric artery is to be traced on the bladder to the umbilicus.
- Nerves. With the vessels are offsets of the hypogastric plexus of nerves, but in the present state of the body these will probably not be seen; and in dissecting the vessels to the bladder and the rectum, branches of the spinal sacral nerves will come into view.
- Veins. The veins in a general dissection may be removed to make clean the arteries.
- When the vessels are quite prepared the bladder may be again distended, and the viscera replaced.
- Destination of internal iliac artery. The INTERNAL ILIAC ARTERY is one of the trunks resulting from the division of the common iliac vessel, and furnishes branches to the viscera and the wall of the pelvis, to the generative organs, and to the thigh.
- Size and length; termination; position of vein; connections. In the adult the vessel is a short trunk, of large capacity, which measures about an inch and a half in length. Directed downwards as far as the sacro-sciatic notch, the artery terminates in two large branches, from which the several offsets are furnished. From the extremity a partly obliterated vessel (hypogastric) extends forwards to the bladder. In entering the pelvis the artery lies in front of the lumbo-sacral nerve and the pyriformis muscle, and is contained in the fold of peritoneum forming the posterior ligament of the bladder. It is accompanied by the internal iliac vein, which is posterior to it, and somewhat on the outer part on the right side.
- Branches. The *branches* of the artery are numerous, and arise usually in the following manner:—From the posterior division of the trunk arise the ilio-lumbar, lateral sacral, and gluteal branches. And from the anterior portion come the vesical (upper and lower) obturator, sciatic, and pudic; and in the female, the uterine and vaginal branches.
- Hypogastric artery in the fetus. *Artery in the fetus.*—In the fetus the *hypogastric artery* takes the place of the internal iliac, and leaves the abdomen by the umbilicus. At that time it is larger than the external iliac artery; and, entering but slightly into the cavity of the pelvis, it is directed forwards to the back of the bladder,

and then upwards along the side of that viscus to the apex. Beyond the bladder the vessel ascends along the posterior aspect of the abdominal wall with the urachus, converging to its fellow. Finally at the umbilicus the vessels of opposite sides come into contact with the umbilical vein, and, passing from the abdomen through the aperture at that spot, enter into the placental cord, and receive the name *umbilical*. In the foetus, as in the adult, similar branches are furnished by the artery, though their relative size at the two periods is very different.

Change to adult state.—When uterine life has ceased the hypogastric artery diminishes in consequence of the arrest of the current of blood through it, and finally becomes obliterated more or less completely as far back as an inch and a half of its commencement, only a cord remaining in the position of the former vessel. The part that is unobliterated becomes the internal iliac; and commonly the cord remains pervious by means of a very small canal as far as the upper part of the bladder, and gives origin to the vesical arteries.

and its transformation into that of the adult.

Peculiarities.—The length of the internal iliac artery varies from half an inch to three inches, its extreme measurements; but in two thirds of a certain number of bodies (Quain) it ranged from an inch to an inch and a half. The increased and diminished extent of the internal, is dependent upon the shortening and lengthening of the common iliac artery.

Trunk varies in length.

The ending of the vessel may be at any spot between the usual place of origin and termination.

and in ending.

The branches arising from the posterior portion of the internal iliac, are, ilio-lumbar, lateral sacral, and gluteal.

Branches of the posterior trunk.

1. The *ilio-lumbar branch* passes outwards beneath the psoas muscle and the obturator nerve, but in front of the lumbo-sacral nerve, and divides into an ascending and a transverse branch in the iliac fossa.

ilio-lumbar has an

a. The ascending or *lumbar offset*, which is beneath the psoas, supplies that muscle and the quadratus lumborum, and anastomoses with the last lumbar artery: it sends a small *spinal branch* through the foramen between the sacrum and the last lumbar vertebra.

ascending and

b. The transverse or *iliac part* divides into branches that ramify in the iliacus muscle, some running over and some beneath it. At the iliac crest these branches anastomose with the lumbar and circumflex iliac arteries; and some twigs from the deep branches communicate with the obturator artery, and enter the innominate bone.

a transverse branch.

2. The *lateral sacral branches* are two in number, superior

Lateral

sacral
arteries

and inferior, but the upper is the largest. They correspond in situation with the lumbar arteries, and form a chain of anastomoses by the side of the apertures in the front of the sacrum. These branches supply the pyriformis and coccygeus muscles, and anastomose with the foregoing, as well as with the middle sacral branch. A small *spinal branch* enters the spinal canal through each aperture in the sacrum.

supply
spinal
branch.

Gluteal
artery.

3. The *gluteal artery* is a short thick trunk, which appears to be the continuation of the posterior division of the internal iliac. Its destination is to the gluteal muscles on the dorsum of the innominate bone; and it is transmitted from the pelvis above the border of the pyriformis muscle, with its accompanying vein and the superior gluteal nerve.

Small
offsets.

In the pelvis this artery gives small *branches* to the contiguous muscles, viz., the iliacus, pyriformis, and obturator, and a nutritious artery to the hip bone.

Branches of
anterior
trunk.
Vesical
arteries;

The branches from the anterior portion of the internal iliac artery are the following :—

three or four
upper,

1. The *vesical arteries*, superior and inferior, are distributed to the upper and lower parts of the bladder.

a. The *upper vesical*, three or four in number, arise at intervals from the partly obliterated hypogastric trunk; the lowest is sometimes called middle vesical branch. Offsets are furnished from these branches to all the body and the upper part of the bladder.

and a
lower,

b. The *lower vesical artery* arises from the front of the internal iliac in common with a branch to the rectum, or with one to the vagina in the female. It is distributed to the base of the bladder, the vesiculæ seminales, and the prostate. A small offset from this artery, or from the upper vesical set, is furnished to the vas deferens, and ascends on it as far as the inguinal canal.

with an
offset to the
rectum.

2. The *branch to the rectum* (middle hæmorrhoidal) is commonly supplied by the inferior vesical, as before said, or by the pudic. It ramifies on the anterior and lower part of the rectum, and on the vagina in the female, and anastomoses with the superior and inferior hæmorrhoidal arteries.

Obturator
artery

courses
across pel-
vis;

3. The *obturator artery* is distributed outside the pelvis, and merely crosses this cavity to reach the aperture of exit. The branch springs usually from the anterior trunk resulting from the division of the internal iliac artery, and is directed forwards below the brim of the pelvis to the aperture in the upper part of the thyroid foramen. Passing from the pelvis by that opening the artery ends in two branches, which join on the membrane closing the thyroid

foramen, and lie beneath the muscle in that situation. In the pelvis the artery has its companion nerve above, and vein below it; and it gives origin to the following small branches:—

a. Iliac branch.—Amongst other small offsets, the obturator furnishes a twig to the iliac fossa to supply the bone and the iliacus muscle; this anastomoses with the ilio-lumbar artery.

b. The pubic branch, arising as the artery is about to leave the pelvis, ascends on the posterior aspect of the pubes, and communicates with the corresponding branch of the opposite side, as well as with an offset sent downwards from the epigastric artery. There may be more than one branch to the pubes.

Peculiarities.—The obturator artery may arise at the front of the pelvis, from the epigastric instead of the internal iliac, and turn down almost vertically to the thyroid aperture. Or, it may arise by two roots, one from the epigastric, another from the internal iliac, the roots varying in size in different instances. The position of the obturator to the internal crural ring, in the instances of its origin from the epigastric, has been before alluded to (p. 511).

In some bodies the obturator may be found to take origin from the external iliac artery.

An account of the frequency with which these different peculiarities occur, will be found in Mr. Quain's work on the "Anatomy of the Arteries." Suffice it to say here, that the origin from the internal iliac is the most frequent; that from the epigastric next; and the origin from the two sources, or from the external iliac artery, the least frequent.

4. The *sciatic artery* is the next largest branch to the gluteal; it is distributed to the buttock, and may be considered the offset by which the internal iliac artery terminates. The artery is continued over the pyriformis muscle and the sacral plexus to the lower part of the sacro-sciatic notch, where it leaves the pelvis between the pyriformis and the coccygeus. External to the pelvis it divides into branches beneath the gluteus maximus muscle. In the pelvis it supplies the pyriformis and coccygeus muscles.

5. The *pubic artery* supplies the perinæum and the genital organs, and has nearly the same connections in the pelvis as the sciatic, from which it often springs. If the artery comes as a separate trunk from the internal iliac, it accompanies the sciatic, though external to it, and leaves the pelvis between the pyriformis and coccygeus. At the back of the pelvis it winds over the ischial spine of the hip bone, and enters the perinæum. (See p. 469.)

Some small offsets.

In the pelvic part of its course the artery gives some unimportant branches, and frequently the middle hæmorrhoidal branch arises from it.

An accessory branch from internal iliac.

Peculiarities.—The pudic artery is sometimes smaller than usual, and fails to supply some of its ordinary perineal branches, especially the terminal for the penis. In those cases the deficient branches are derived from an artery, *accessory pudic* (Quain), which takes origin mostly from the trunk of the pudic inside the pelvis, and courses forwards on the side of the bladder and the upper part of the prostate gland, to leave the pelvis below the pubic arch. It furnishes branches to supply the place of those that are wanting.

Branches in the female.

The branches of the internal iliac artery that are peculiar to the female are two, the uterine and vaginal.

Uterine artery

6. The *uterine artery* passes inwards, between the layers of the broad ligament to the neck of the uterus. At that part the vessel changes its direction, and ascends along the side of the uterus to the fundus, where it anastomoses with the ovarian artery (spermatic) of the aorta. Numerous branches enter the substance of the uterus, ramifying in it, and anastomose with those of the opposite side. This artery and its branches are remarkable for their tortuous condition.

supplies uterus.

Offsets to vagina,

a. At the neck of the uterus some small twigs are supplied to the vagina and the bladder; and the special vaginal artery may arise from it at that spot.

and the broad ligament.

b. *Branches in the broad ligament.*—One branch accompanies the round ligament into the inguinal canal, and anastomoses with a branch of the epigastric. Another extends on the Fallopian tube, and divides into long branches that reach the end. And a third offset, according to J. Weber, is distributed to the ovary.

Vaginal artery.

7. The *vaginal artery* seldom arises separately from the internal iliac: combined with the preceding, or with the branch to the rectum, this artery extends to the vagina, and ramifies in its wall as low as the outer orifice.

Branches of the aorta.

Other arteries in the pelvis.—The remaining arteries in the pelvis, which are not derived from the internal iliac, are the ovarian, superior hæmorrhoidal, and middle sacral.

Ovarian artery.

The *ovarian artery* has been described in part with the branches of the aorta, and has been traced to the pelvis (p. 588). After passing the brim of the pelvis it becomes tortuous, and enters the broad ligament to be distributed to the ovary: in the ligament there is a free anastomosis between the ovarian and uterine arteries.

The *superior hæmorrhoidal artery* is the continuation of the trunk of the inferior mesenteric behind the rectum, and divides into two branches near the middle of the sacrum. From the point of the division of the trunk these branches are continued along the rectum, one on each side; and finally end in about six branches, which pierce the muscular layer of the gut three inches from the end, and terminate in anastomotic loops beneath the mucous membrane, and opposite the inner sphincter: they anastomose with the other vessels, viz., the middle and inferior hæmorrhoidal arteries.

Superior hæmorrhoidal.

The *middle sacral artery*, a small branch from the bifurcation of the aorta, descends along the middle line of the body over the last lumbar vertebra, the sacrum, and the coccyx, and terminates at the lower part of the spinal column by anastomosing with the lateral sacral arteries.

Middle sacral, which

In its course the artery gives small branches laterally, opposite each piece of the sacrum, to anastomose with the lateral sacral arteries, and supply the nerves, and the bones with their periosteum. Sometimes a small branch is furnished by it to the lower end of the rectum, which takes the place of the middle hæmorrhoidal artery.

has lateral offsets.

The *INTERNAL ILIAC VEIN* receives the blood from the wall of the pelvis and the pelvic viscera, by branches corresponding for the most part with those of the arteries. The vein is a short and thick trunk, which is situate at first on the inner side of the internal iliac artery; but as it ascends to join with the external iliac it passes behind, and on the right side reaches even the outer aspect of its companion artery.

Internal iliac vein: position to its artery.

Branches.—Some of the branches forming the trunk of the internal iliac vein, viz., the gluteal, obturator, and sciatic, have the same anatomy as the arteries; but the following visceral branches,—the pudic and dorsal of the penis, the vesical and hæmorrhoidal, the uterine and vaginal, have some peculiarities.

Its branches that are peculiar are

The *pudic vein* receives roots corresponding with the branches of the artery in the perinæum, but not those corresponding with the offsets of the artery on the dorsum of the penis. Its hæmorrhoidal branch commences in a large plexus around the lower end of the rectum beneath the mucous membrane (plexus hæmorrhoidalis), with which the superior hæmorrhoidal vein communicates.

The *dorsal vein* of the penis receives roots from the corpora cavernosa and corpus spongiosum of the penis, and piercing

dorsal vein of penis,

the triangular ligament of the urethra, divides into two, a right and a left branch, which enter a plexus around the membranous part of the urethra and the prostate.

vesical, The *vesical veins* commence in a plexus about the lower part of the bladder, and anastomose with the prostatic and hæmorrhoidal veins.

uterine, and The *uterine veins* are numerous, and form a plexus in and by the side of the uterus. This plexus inosculates above with the ovarian plexus, and below with one on the vagina.

vaginal veins. The *vaginal veins* surround the vagina with a large vascular plexus.

Parietal veins. *Parietal veins of the pelvis.*—The other veins of the wall of the pelvis, viz., the ilio-lumbar, lateral sacral, and middle sacral, open into the common iliac vein.

Dissection of the nerves of the pelvis, *Dissection.*—To dissect the nerves of the pelvis on the right side it will be necessary to detach the urethra from the arch of the pubes, and to cut through on the right side the recto-vesical fascia and the levator ani, together with the visceral arteries, in order that the viscera may be drawn from the side of the pelvis. If the bladder is distended let the air escape from it.

sacral and coccygeal, By means of this dissection the sacral nerves will be seen as they issue from the sacral foramina. The dissector should follow the first four into the sacral plexus, as well as some branches from the fourth to the viscera. A branch of nerve, superior gluteal, is to be shown arising from the lumbo-sacral cord, as this passes to the sacral plexus. The last sacral and the coccygeal nerve are of small size, and will be found coming through the coccygeus muscle close to the coccyx; these are to be dissected with care, and the student will find them best by tracing the connecting filaments which pass from one to another, beginning above with the offset from the fourth nerve.

and sympathetic. Opposite the lower part of the rectum, bladder, and vagina is a large plexus of the sympathetic, the pelvic plexus, which sends offsets to the viscera along the arteries. This plexus is generally destroyed in this stage of the dissection; but if it should remain the student may trace the offsets from it, and the communicating branches with the spinal nerves.

Sacral nerves are five; *SPINAL SACRAL NERVES.*—The anterior primary branches of the sacral nerves are five in number, and decrease suddenly in size from above downwards; for whilst the first two are large trunks, the last two are small and slender. Issuing by the apertures in the front of the sacrum (the fifth nerve

excepted), the nerves receive short filaments of communication from the gangliated cord of the sympathetic. The first three nerves and part of the fourth enter the sacral plexus, but the fifth ends on the back of the coccyx. those that are peculiar are

The peculiarities of the fourth and fifth sacral, and the coccygeal nerve, will be noticed before the plexus formed by the other nerves is described.

The *fourth nerve* divides into two parts, as above stated:— fourth, one communicates with the sacral plexus; the other distributes the following branches to the viscera and the surrounding muscles, and joins the fifth nerve. which gives

a. The visceral branches supply chiefly the bladder and the vagina, and communicate with the sympathetic nerve to form the pelvic plexus. Sometimes these branches come from the third sacral nerve. viscera.

b. The muscular branches are three in number. One rather long branch enters the levator ani on its visceral aspect; another supplies the coccygeus; and the third reaches the perineum by piercing the coccygeus muscle. (See page 460). and muscular offsets

The *fifth nerve* comes forwards from the lower end of the spinal canal through the coccygeus muscle. As soon as it appears in the pelvis it receives the communicating branch from the fourth nerve; it is then directed downwards in front of the coccygeus, where it is joined by the coccygeal nerve, and perforates that muscle near the tip of the coccyx, to end on the posterior surface of the bone. Fifth is below apertures in sacrum, ends on coccyx.

The *coccygeal nerve* (sixth sacral), after leaving the lower end of the spinal canal, appears through the coccygeus muscle, and joins the fifth sacral nerve in the manner above stated. Coccygeal nerve.

SACRAL PLEXUS.—This plexus is a large flat band, in which are united the lumbo-sacral cord, the first three sacral nerves, and part of the fourth sacral nerve. It is situated on the pyriformis muscle, and beneath the sciatic and pudic branches of the internal iliac artery. From the spot where the nerves join, the plexus becomes gradually smaller towards the lower end; and, leaving the pelvis below the pyriformis, it terminates in branches for the lower limb. Sacral plexus; situation and form.

Branches.—Most of the branches of the plexus arise outside the pelvis, and are distributed to the back of the lower limb. Only two internal muscles of the pelvis (pyriformis and obturator internus) receive nerves from the sacral plexus. Branches to muscles inside the pelvis;

The *nerve of the obturator internus muscle* arises from the part of the plexus formed by the union of the lumbo-sacral

with the first sacral nerve ; it leaves the pelvis with the pudic artery, and winds over the ischial spine of the hip bone and through the small sacro-sciatic notch to enter the muscle on the perineal surface.

two to pyriformis. The *nerves of the pyriformis* are commonly two in number, and arise from separate parts of the plexus : they enter the muscle at its visceral aspect.

Pudic nerve The *pudic nerve*, like the artery of the same name, supplies the rectum, the perinæum, and the genital organs. The nerve arises at the lower part of the plexus, and accompanies its artery through the small sacro-sciatic notch to the perinæum. (See p. 470.)

now seen at its origin. Branches to the lower limb after. The remaining branches of the plexus, viz., the small and great sciatic nerves, with small muscular offsets to the gemelli and quadratus femoris, are described with the lower limb.—See the Dissection of the Buttock.

Superior gluteal nerve The *superior gluteal nerve* is a branch of the lumbo-sacral cord, and arises opposite the upper part of the large sacro-sciatic notch. It passes outwards above the pyriformis muscle to the back of the pelvis, where it ends chiefly in branches for the two smaller gluteal muscles.

Trace out the sympathetic. *Dissection.*—Besides the large plexus of the sympathetic by the side of the bladder, the student will have to dissect the part of the gangliated cord that lies in front of the sacrum : its several ganglia (three or four), and their branches will come into view on the removal of the areolar tissue.

Sympathetic in the pelvis. SYMPATHETIC NERVE.—In the pelvis the sympathetic nerve consists of a gangliated cord on each side, and of two lateral plexuses for the supply of the viscera.

The gangliated cord The GANGLIATED CORD lies on the front of the sacrum and internal to the series of apertures in that bone. It is continuous superiorly with the lumbar part of the cord by a single or double internodal piece ; whilst inferiorly the cords of opposite sides converge, and are united in front of the coccyx by means of a loop, on which is situate a single median ganglion (*gang. impar*). Each cord is marked by ganglia at intervals, the number varying from three to five. From the ganglia branches of communication pass to the spinal nerves, and some filaments are directed inwards in front of the sacrum.

Offsets of the ganglia joins that of opposite side below in a ganglion. The *connecting branches* are two to each ganglion, gray and white, and are very short ; and like those of the lumbar ganglia, they may enter two sacral nerves instead of one. The gray connecting cord unites the ganglion and the spinal

to the spinal nerves.

nerve, but the white one is continued over the ganglion to the plexuses for the viscera.*

The *internal branches* are smaller than those of the other parts of the cord, and communicate in front of the sacrum, and around the middle sacral artery, with branches from the opposite side. From the first, or first two ganglia, some filaments are furnished to the hypogastric plexus; and from the terminal connecting branches and the ganglion impar, in front of the coccyx, offsets descend over that bone.

The VISCERAL OR PELVIC PLEXUSES (lateral inferior hypogastric) are two in number, right and left, and are continuous with the lateral prolongations of the hypogastric plexus (p. 531). Each is situated by the side of the bladder and the rectum, or by the side of the vagina in the female, and is united with offsets from the third and fourth sacral nerves to constitute the above-named plexus. Numerous ganglia are found in the plexus, especially at the points of union of the spinal and sympathetic nerves.

Offsets.—From each plexus offsets are furnished to the viscera of the pelvis, and to the genital organs, along the branches of the internal iliac artery. These different secondary plexuses have the same name as the vessels on which they are placed; but as they may not be seen in the dissection, a mere enumeration of them will be sufficient.

The *inferior hæmorrhoidal plexus* is an offset to the rectum from the back of the plexus, and joins the sympathetic on the superior hæmorrhoidal artery.

The *vesical plexus* contains large offsets, with many white fibred or spinal nerves, and passes forwards to the side and lower part of the bladder. It gives one plexus to the vesicula seminalis, and another to the vas deferens.

The *prostatic plexus* leaves the lower part of the pelvic plexus and is distributed to the substance of the prostate gland. At the front of the prostate an offset (cavernous) is continued onwards to the dorsum of the penis, to supply the cavernous structure. On the penis the cavernous nerves join the pudic nerve.

In the female there are the following additional plexuses for the supply of the viscera peculiar to that sex:—

Ovarian plexus.—The principal nerves to the ovary are derived from the renal and aortic plexuses, and accompany the artery to that body; but the uterine nerves supply also some filaments to it.

* See a Paper on the "Nerves of the Uterus," by Dr. T. S. Beck, in the "Philosophical Transactions" for 1846.

to the
vagina ;

Vaginal plexus.—The nerves to the vagina are of large size, and are not plexiform, but consist in greater part of spinal nerve fibres ; they end in the lower part of the tube.

and to the
uterus :

The *uterine nerves* are furnished to the uterus without direct admixture with the spinal nerves. The nerves ascend along the side of the uterus, and are, for the most part, long slender filaments, without ganglia or communications as far as their termination in the substance of the viscus. The Fallopian tube receives its branches from the uterine nerves.

except on
vessels.

Some few nerves surrounding the arteries of the uterus are plexiform and ganglionic.—Beck.

Chain of
glands in
pelvis ;

The *lymphatic glands* of the pelvis form a chain in front of the sacrum, and along the internal iliac artery. The efferent ducts of these bodies join the lumbar glands. Into these glands the deep lymphatics of the penis, those of the genital organs in the female, and the lymphatics of the viscera and wall of the pelvis are collected.

lymphatics
entering
them.

SECTION V.

ANATOMY OF THE VISCERA OF THE MALE PELVIS.

Directions.—The bladder and the parts at its base, viz., the vesiculæ seminales and the prostate gland, are to be taken first for examination.*

Take out the
viscera.

Dissection.—To study the form and structure of the viscera, it will be necessary to remove them from the cavity of the pelvis. For this purpose the student should carry the scalpel around the pelvic outlet, close to the osseous boundary, so as to detach the crus of the penis from the bone, and to divide the parts connected with the end of the rectum.

Clean the
bladder and
prostate.

When the viscera are removed, the rectum is to be separated from the other organs ; but the bladder, the penis, and the urethra are to remain united. After the bladder has been distended with air, the peritoneum and the areolar tissue are to be dissected from the muscular fibres. The prostate gland and the vesiculæ seminales are to be then

* The anatomy of the viscera of the female pelvis is described in Section VI. p. 646.

cleaned ; and the duct of the latter, with the vas deferens, is to be followed into the gland. If any of the integument has been left on the penis and the urethra it is to be taken away.

THE PROSTATE GLAND AND SEMINAL VESICLES.

PROSTATE GLAND.—This is a firm muscular and glandular body which secretes a special fluid, and surrounds the neck of the bladder and the beginning of the urethra. Its connections with the surrounding parts have been enumerated (p. 612).

Prostate gland : use and situation.

This body is conical in form, with the base or larger end directed backwards, and is usually likened to a chesnut, which it resembles much. Its dimensions in different directions are the following :—Transversely at the base it measures about an inch and a half ; from apex to base rather more than an inch ; and in depth about three quarters of an inch or an inch : so that an incision directed obliquely downwards and outwards from the apex to the base, at the lateral part, will be the longest that can be practised in the half of this body. Its weight is about an ounce, but in this respect it varies greatly.

Form, dimensions,

The upper surface of the prostate is rounded, but a slight groove lies along the middle. The under surface, which is larger and flatter, is marked by a median hollow that indicates the division into lateral lobes. The posterior part, or the base, is thick, and in its centre is an excavation which receives the common ejaculatory ducts.

Surfaces ; and base.

Three lobes are described in the prostate, viz., a middle and two lateral, though there is no fissure in the firm mass. The lateral parts or lobes are similar on both sides, and are separated only by the hollow on the under surface ; they form the chief part of the prostate, and are prolonged back, on each side, beyond the notch in the base. The middle lobe will be brought into view by detaching the vesiculæ seminales and the ejaculatory ducts from the bladder ; it is a small piece of the gland between the neck of the bladder and the ejaculatory ducts, which extends transversely between the lateral lobes. Oftentimes this middle lobe is enlarged in old people, and projects upwards into the bladder, so as to interfere with the flow of the urine from that viscus, or the passage of a catheter into it.

Three lobes ; two lateral and a central.

The urethra and the two common ejaculatory ducts are contained in the substance of the prostate. The former is transmitted through the gland from base to apex ; and

Gland contains three tubes.

the latter perforate it obliquely to terminate in the urethral canal.

Structure. *Structure.*—On a section the gland appears reddish in colour, is very firm to the feel, and is scarcely lacerable. It is made up of a mass of involuntary muscular and some fibrous tissue with interspersed glandular structure; and the whole is enveloped by a fibrous coat.

Fibrous case distinct from pelvic fascia; *Fibrous covering.*—This forms a thin investment for the gland, and sends offsets into the interior. It is quite distinct from the dense capsule derived from the pelvic fascia, and is separated from that sheath by a plexus of veins.

Muscular and fibrous tissue; how arranged. *Muscular tissue.*—The firm part of the gland consists of involuntary muscular fibres, intermixed with elastic and fibrous tissues. The muscular fibres are arranged circularly around the tube of the urethra: they are continuous behind with the annular fibres of the bladder, and in front with a layer of circular fibres around the membranous part of the urethra. At the lower and outer parts of the gland the texture is looser and more spongy, especially where the glands are situate and where the larger vessels enter.* This arrangement will be better seen afterwards when the urethra has been opened.

Glands only few; *Glandular structure.*—This element, forming but about one third of the whole gland, is in greatest abundance towards the circumference and in the part called middle lobe. The ducts are branched as in other glands; and when they are traced into the interior from the urethra, the final radicles will be found to be surrounded by small sessile vesicles, which open into them. On the exterior of the vesicles and the ducts the bloodvessels ramify; and lining the interior of the tubes is an epithelium of the columnar kind, which becomes laminar in the vesicles. The ducts of the glands are not collected into one excretory tube, but vary in number from twelve to twenty, and open into the prostatic part of the urethra (p. 639).

Arteries. *Bloodvessels.*—The *arteries* are unimportant, and are furnished by the vesical and hæmorrhoidal (p. 622). The *veins* are joined in a plexus around the gland, which communicates in front with the dorsal vein of the penis, and behind with a plexus of veins at the base of the bladder. In old men this vascular communication gives rise to considerable hæmorrhage in the operation of lithotomy.

Veins form a plexus.

* See a Paper by the Author in vol. xxxix. of the Med. Chir. Transactions. (1856.)

VESICULÆ SEMINALES.—These vesicles are two membranous sacs which serve as reservoirs for the secreted semen. They are placed on the under part of the bladder behind the prostate (fig. 93, *s*), and diverge from one another so as to limit laterally a triangular surface at this aspect of the

Seminal vesicles.

Definition.

Situation.

Fig. 93.*



viscus: their form and connections have been already described (p. 613). Though sacculated behind, the vesicula becomes straight and somewhat narrowed in front; and at the base of the prostate it blends with the vas deferens to form the common ejaculatory duct.

Sacculated.

The vesicula seminalis consists, like the epididymis, of a tube bent into a zigzag form, so as to produce lateral sacs or pouches, which are bound together by fibrous tissue; this cellular structure will be shown by means of a cut into it. When the bends of the vesicle are undone, its formative tube, which is about the size of a quill, measures from four

Formed of a coiled tube.

Length and size.

* View of the under part of the bladder with the vesiculæ seminales and vasa deferentia (Haller). *b*. Bladder. *u*. Ureter. *p*. Prostate. *i*. Left vas deferens. *s*. Vesicula seminalis: the same on the right side is unravell'd. *e*. Left ejaculatory duct formed by the union of the vesicula seminalis with the vas deferens.

to six inches, and ends posteriorly in a closed extremity: connected with the tube, at intervals, are some lateral cæcal appendages (fig. 93).

End of vas deferens.

End of vas deferens (fig. 93, i).—Opposite the vesicula the vas deferens is increased in capacity, and is rather sacculated like the contiguous vesicle; but before it joins the tube of that body to form the common ejaculatory duct, it diminishes in size, and becomes straight.

Vesicle has a special coat:

Structure.—The seminal vesicle has the same number of coats, and the same kind of strata as the vas deferens (p. 582).

a covering of muscular fibres;

Within the casing of the recto-vesical fascia, the vesiculæ and vasa deferentia are covered by a muscular layer of transverse and longitudinal involuntary fibres. The transverse are the more superficial (the base of the bladder being upwards), are strongest near the prostate, and act most on the vasa deferentia. The longitudinal fibres, placed chiefly on the sides of the vesiculæ, are continued forwards with the common seminal ducts to the urethra. The *mucous membrane* is thrown into ridges by the bending of the tube, and presents an areolar or honeycomb appearance: it is covered by a laminar epithelium. In the sacculated part of the vas deferens the mucous lining resembles that in the vesicula in a slight degree.

and a mucous coat.

Seminal ducts, how formed.

Common seminal ducts(e).—These tubes (right and left) are formed by the junction of the narrowed front of the vesicula seminalis with the vas deferens of the same side, and convey the semen to the urethra. They begin opposite the base of the prostate, and are directed upwards and forwards through an aperture in the circular prostatic fibres, and along the sides of a hollow (vesicula prostatica), to open into the urethral tube. Their length is rather less than an inch, and their course is convergent to their termination, where they are close together in the floor of the urethra (p. 639).

Structure.

Structure.—The wall of the common duct is thinner than that of the vas deferens, but it possesses similar coats. It is surrounded by longitudinal involuntary muscular fibres, which blend with the submucous stratum of the urethra.

THE BLADDER.

Bladder out of the body.

After the bladder has been separated from the surrounding parts, its form, and the extent of its different regions can be more conveniently observed.

Form.

Whilst the bladder is in the body, it is conical in shape,

and rather flattened from before backwards. But out of the body it is more circular than when in its natural position, and it loses that arched form by which it adapts itself in distension to the curve of the pelvis. If this viscus is moderately dilated, it measures about five inches in length, and about three inches across.—Huschke. Its capacity is greatly influenced by the age and sex, and by the habits of the person. Ordinarily the bladder holds about a pint, and as a general rule it is larger in the female than in the male.

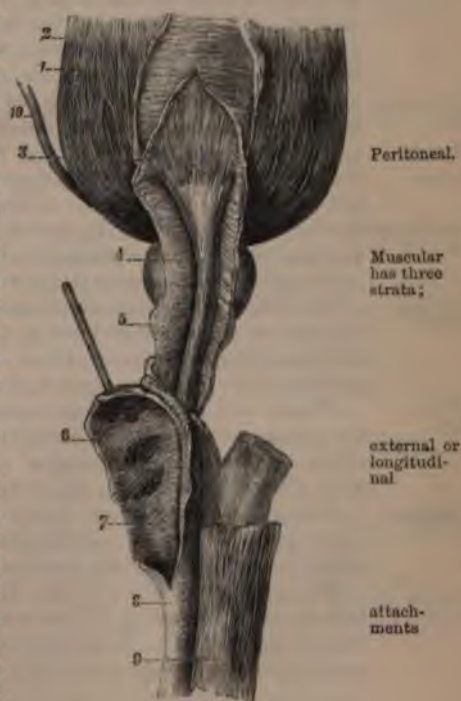
STRUCTURE.—A muscular and a mucous coat, with an intervening fibrous layer, exist in the wall of the bladder: at certain parts the peritoneum may be also enumerated as a constituent of the wall. The vessels and nerves are large.

The imperfect covering of *peritoneum* has been described (p. 609), and has been removed.

The *muscular* coat is formed of thin strata of unstriated muscular fibres, viz., an external or longitudinal, a middle or circular, and an internal or submucous.

The *longitudinal* fibres (fig. 94, 1) form a continuous covering, with the usual plexiform disposition of the muscular bundles, and extend from the apex to the base. Above, some are connected with the urachus, and others are inserted into the peritoneum. Below, the posterior and lateral fibres enter the prostate becoming circular; whilst the anterior are attached to the fascia covering the

Fig. 94.*



* Muscular fibres of the bladder, prostate, and urethra. 1. External or longitudinal fibres of the bladder. 2. Circular fibres of the middle

forms
detrusor
urinae;

internal or
circular
gives rise to
sphincter;
continuous
with pros-
tate;

sub-mucous
layer.

Extent.

Fibres.

Addition to
it.

Strata are
joined.

Fibrous
coat.

Open the
bladder.

Mucous
coat

prostate, with the exception of a fasciculus on each side, which is united to the back of the pubes through the anterior true ligament of the bladder. On the front and back of the bladder the muscular layer is stronger, and its fibres more vertical, than on the lateral parts. Sometimes this outer layer of fibres has been called *detrusor urinae* from its action in the expulsion of the urine.

The *circular* fibres (fig. 94, ²) are thin and scattered on the body of the bladder; but around the cervix they are collected into a thick bundle, called the *sphincter vesicae*, and are continuous before with the fibres of the prostate. In some instances the fibres are hypertrophied, and project into the interior of the organ, forming the fasciculated bladder; and in other bodies the mucous coat may be forced outwards here and there between the fibres, in the form of sacs, producing the sacculated bladder.

The *submucous* stratum (fig. 94, ³) forms a continuous layer over the lower half of the bladder, but its fibres are scattered above. In the lower third of the bladder the fibres are longitudinal, and continuous with the fibres around the urethra, but they become oblique above that point. At the back of the bladder the layer is increased in strength by the longitudinal fibres of the ureters blending with it. The projection of the uvula vesicae is due to this submucous stratum.

The different muscular strata communicate freely, so that one cannot be separated from another without division of the connecting bundles of fibres. In both sexes the disposition of the muscular fibres is similar.*

Fibrous coat.—The stratum is placed between the muscular and mucous layers, and is enumerated amongst the coats of the bladder; it is composed of areolar and elastic tissues as in other hollow viscera, and in it the bloodvessels ramify.

Dissection.—The bladder is now to be opened by an incision down the front; and the same cut is to be continued along the upper part of the prostate gland.

The *mucous membrane* of the bladder is continuous posteriorly with the lining of the ureters, and anteriorly with that of the urethra. It is very slightly united to the muscular layer in consequence of the intervention of the sub-

coat. 3. Submucous layer. 4. Muscular layer around the urethra. 5. Circular fibres of the prostate and urethra continuous with the circular of the bladder. 6, 7. Septum of the corpus spongiosum. 8. Corpus spongiosum. 9. Corpus cavernosum. 10. Ureter.

* See a Paper before referred to in the Trans. of the Med. Chir. Society, 1856.

mucous fibrous stratum ; and it is thrown into numerous folds in the flaccid state of the viscus, except over a small triangular surface behind the opening into the urethra. The membrane is soft and smooth to the feel, and of a pale rose colour in the healthy state. Its surface is studded with small mucous follicles, particularly towards the neck of the bladder. A laminar *epithelium* covers the surface, of which the superficial cells are roundish and flattened, but the deeper are conical or cylindrical (Kölliker).

Interior of the bladder.—Within the bladder the following parts are to be remarked, viz., the orifices of the ureters and urethra, with the triangular space (fig. 71).

Orifices.—At the lower and anterior part of the bladder is the orifice of the urethra, surrounded by the prostatic gland. The mucous membrane presents here some longitudinal folds ; and the aperture is partly closed by a small prominence below, *uvula vesicæ*, occasioned by a thickening of the submucous muscular and fibrous layer. This eminence is placed in front of the middle lobe of the prostate, and from its anterior part a slight ridge is continued on the floor of the urethra.

About an inch and a half behind the orifice of the urethra, and rather more than that distance apart, are the two narrow openings of the ureters. These excretory tubes for the urine perforate the wall of the bladder obliquely, lying in it for the distance of half an inch, and therefore the reflux of fluid through them towards the kidney is prevented as the bladder is distended. They terminate on each side by a contracted slit-like opening in the centre of a prominence.

Triangular surface.—Immediately behind the orifice of the urethra is a smooth triangularly-shaped part of the bladder, which is named *trigone* (*trigonum vesicæ*). Its apex reaches the prostate, and its base the ureters. Its boundaries may be marked out by a line on each side from the urethra to the ureter, and by a transverse one behind between the openings of the ureters. This space corresponds with the interval, at the base of the bladder, between the prostate in front and the vesiculæ and vasa deferentia on the sides ; and over it the mucous coat is more closely united to the fibrous and muscular, so as to prevent the accidental folds found in the other parts of the empty bladder.

Dissection.—The ending of the ureters will come into view on the removal of the mucous membrane from the lower third of the bladder ; the fibres are best marked in a muscular bladder.

Muscular
fibres of
ureters.

Ending of the ureters.—As soon as the ureter pierces the outer and middle coats of the bladder, its longitudinal fibres are thus disposed :—The more internal and strongest are directed transversely, and join with the corresponding fibres of the other urine tube ; whilst the remainder are continued down over the triangular space and join the submucous layer.*

Arteries ;
veins ;

Bloodvessels and nerves.—The source of the vesical *arteries*, and the termination of the *veins* are before detailed (pp. 622, 626). In the bladder the vessels are disposed in greatest

nerves of
the bladder.

number about the base and neck. Most of the *nerves* distributed to the bladder, though supplied from the pelvic plexus of the sympathetic (p. 629), are derived directly from the spinal nerves.

THE URETHRA AND PENIS.

Urethra :
extent and
length ;

URETHRA.—The tube of the urethra extends from the neck of the bladder to the end of the penis, and has an average length of about eight inches and a half. This canal is supported by the prostate, by the spongy structure of the penis, and by muscular fibre, so that it does not require so thick a continuous muscular coat as in many other excretory tubes. The size of the urethra varies at different spots, and the tube is divided, as before said (p. 613), into a prostatic, a membranous, and a spongy part.

no special
coat.

Division
into parts.

How to
open the
urethra.

Dissection.—To open the urethra, let the incision through the upper part of the prostate be continued onwards to the extremity of the penis, so as to divide the corpus cavernosum rather on one side of the middle line, and to leave uncut the septum in it.

Prostatic
part.

Dimensions
and

shape ;

diameter.

The *prostatic* part is nearer the upper than the lower surface of the muscular mass surrounding it. It is about one inch and a quarter in length, and is altogether the widest and most extensible portion of the urethral canal. The form of this part of the tube is spindle-shaped, for it is larger in the middle than at either end. Its transverse measurement at the neck of the bladder, is about a quarter of an inch ; at the centre a line or two more ; and at the front rather less than at the back.

On the floor
is a crest.

On the floor of the passage at the neck of the bladder is

* Trans. of Med. Chir. Society, 1856. Sir C. Bell described these fibres as distinct muscles for the purpose of acting on the opening of the ureter. See the Med. Chir. Transactions, vol. iii. : "Account of the Muscles of the Ureters."

the eminence of the uvula vesicæ. In front of this is a central longitudinal ridge of the mucous lining, about three quarters of an inch in length and larger behind than before, which is prolonged anteriorly towards the membranous part of the canal, and is named *crest* of the urethra (*veru montanum, caput gallinaginis*) ; it is formed like the uvula by a bundle of the submucous muscular fibres. In the central fold or crest of the mucous membrane, near its posterior extremity, is a slight hollow named *vesicula prostatica* or *sinus pocularis*.

In the crest is a pouch.

The depression in the mucous fold, or the *vesicula prostatica*, is a cæcal appendage to the urethral canal, and is directed backwards and downwards in the substance of the prostate, for the distance of a quarter of an inch or less, passing beneath the middle and between the lateral lobes. Its orifice in the urethra is about a line wide, and its closed extremity is dilated. In its wall, on each side, is contained the common ejaculatory duct, which opens by a narrow slit on or within the free margin of the mouth of the sac. Small glands open likewise on the surface of the mucous membrane lining it. Some bristles should be introduced into the ejaculatory ducts, to render evident their position and apertures.

Vesicula projects into the prostate,

and in it are the ejaculatory ducts.

On each side of the central ridge or crest is an excavation which is named the *prostatic sinus*. Into this hollow the greater number of the ducts of the prostate open ; whilst the apertures of others are seen at the posterior part of the central ridge, behind the hollow in it.

Prostatic sinuses also in floor.

The *membranous part* of the urethra is nearly an inch in length, and intervenes between the apex of the prostate gland and the bulb of the corpus spongiosum urethræ. In its interior are slight longitudinal folds. This is the narrowest portion of the whole tube, with the exception of the orifice, and measures rather less than a quarter of an inch across. It is the weakest of the three portions of the canal, and is supported by a thin stratum of erectile tissue, by a thin layer of involuntary circular fibres (p. 468), and outside all by the compressor urethræ muscle.

Membranous part.

Dimensions.

Parts around.

The *spongy part* reaches onwards to the end of the penis. It is about six inches in length. And its strength depends upon a surrounding material, named corpus spongiosum urethræ. The average size of the canal is about a quarter of an inch in diameter, though at the vertical slit (*meatus urinarius*), by which it terminates on the glans penis, the tube is smaller than elsewhere. Two dilatations exist in the

Spongy part.

Dimensions.

Two dilata-

- tions :
one in bulb,
one in glans.
- Lacunæ.
- One larger
than the
rest.
Ducts of
glands of
Cowper.
- Mucous
membrane:
extent ;
- colour ;
- folds ;
- glands ;
- epithelium.
- Submucous
tissue ;
- nature ;
- arrange-
ment in
prostate,
in mem-
branous,
and in
spongy
parts.
Erectile
tissue
throughout.
- Penis
formed of
two vascular
erectile
bodies.
- floor of the spongy portion :—one is contained in the bulb or bulbous part of the urethra, and is named *sinus* of the bulb ; the other is situate in the glans penis, and has been called *fossa navicularis* from its shape. Many small pouches or *lacunæ* are seen in the interior of the canal, chiefly along the floor, as far back as the membranous part, and have their apertures turned towards the outer orifice of the urethra. One of these is larger than the rest, *lacuna magna*, and is placed generally on the upper boundary or the roof of the urethra, opposite the fossa navicularis. The ducts of Cowper's glands open on the mucous membrane : they are two in number, and terminate, one on each side, on the floor of the urethra near the front of the bulb, but in the ordinary examination they are seldom to be recognised.
- Mucous lining of the urethra.*—The mucous membrane of the urethra is continued into the bladder, as well as into the ducts opening into the canal, and joins in front the tegumentary covering of the glans penis. It is of a reddish colour in the spongy and membranous portions, but in the prostate it becomes whiter. In the spongy and membranous parts it is thrown into longitudinal folds during the contracted state of the penis. Its surface is studded with follicles, and with the apertures of branched mucous glands ; and it is provided with papillæ towards the external orifice. Its *epithelial* covering is of the columnar kind, but near the meatus externus this becomes laminar.
- Submucous tissue.*—Beneath the mucous lining of the urethra is a stratum of longitudinal involuntary muscular fibres mixed with elastic and fibrous tissues. It is continuous behind with the submucous fibres of the bladder, and is joined in the prostate by the fibres accompanying the common seminal ducts. This structure differs in quantity along the canal. It is most developed in the prostate, where it forms the projection of the crest and blends with the circular fibres of that body. In the membranous portion of the canal the muscular structure is less abundant. In the spongy part the submucous structure is richer in fibrous constituents.
- In the prostatic and membranous divisions of the urethra there is, in addition, a thin enveloping layer of vascular or erectile tissue, which is continued backwards from the corpus spongiosum urethræ to the neck of the bladder.
- STRUCTURE OF THE PENIS.*—The form and the connec-
tions of the penis having been described at page 614, the
tissues of which it is composed remain to be noticed. The
section already made through the penis shows this body to

be made up of two masses of spongy and vascular tissue incased in fibrous coverings—one constituting the corpora cavernosa, the other the corpus spongiosum urethræ.

Corpora cavernosa.—Each of the two corpora cavernosa is constructed of a fibrous tunic, which encloses a cavernous or trabecular structure with vessels in the intervals of the spongy mass. An incomplete median septum exists along the body of the penis between the corpora cavernosa.

Cavernous body; the structures of which it consists.

The fibrous case of the corpus cavernosum is a white, strong, elastic covering, from half a line to a line in thickness. Along the middle line of the penis a septal process is sent inwards from it; and numerous other finer bands or trabeculæ of the spongy structure are connected with its inner surface. It is formed of white shining fibres that are disposed in two layers, outer and inner. The outer stratum (fig. 95, *b*) is formed of longitudinal fibres with close meshes, arranged like involuntary muscular tissue. The inner stratum

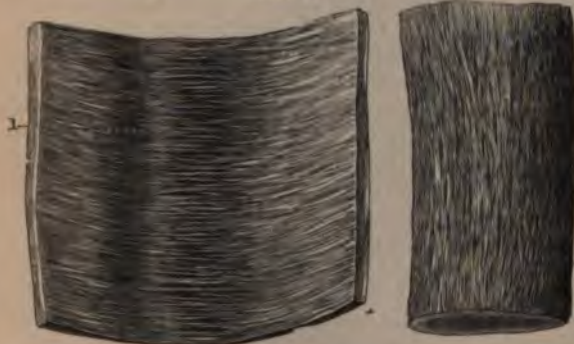
A case that sends in processes.

Fibres form strata:

inner forms septum.

a Fig. 95.*

b



tum (fig. 95, *a*) consists of circular fibres, with a like plexiform disposition; and the circular fibres of each cavernous body meeting in the middle line give rise to the septum penis. Both strata are inseparably united by communicating bundles, as in the intestine.†

* *b*. View of the external or longitudinal layer of the corpus cavernosum. *a*. Inner or circular fibres of the corpus cavernosum. 1. The pectiniform septum.

† The existence of two strata—one longitudinal, the other circular—is mentioned by Dr. James Wilson, in 1821, in his *Lectures on the Genital and Urinary Organs*. The fact has been overlooked by anatomists since that time.

One septal
piece,

which is im-
perfect ;

how
formed ;

and nu-
merous
bands and
cords to
form a net-
work.

The septal process extends along the body of the penis, and is thicker and more perfect behind than in front. At the point of junction of the crura of the penis, this partition separates the enclosed cavity of the organ into two parts ; but as it reaches forwards it becomes less strong, and is pierced by elongated apertures (fig. 95, ¹), which give it the appearance of a comb, from which the name *septum pectini-forme* is derived. Through the intervals in the septum the vessels in the corpora cavernosa communicate. It is formed, as above said, by the circular fibres of the cavernous bodies.

The cavernous or trabecular structure is a network of fine cords, which fills the interior of the corpora cavernosa. The processes are thinner towards the centre than at the circumference of the fibrous case ; and the areolar spaces are larger in the middle and at the fore part of the contained cavity,

Fig. 96.*



than at the circumference or in the crura of the penis. In addition to white fibrous tissue, the trabeculae contain elastic fibres and involuntary muscular fibres (Müller). The cellular structure may be demonstrated by sections of the penis after it has been distended with air and dried.

* Magnified view of the trabecular structure and arteries of the penis (Müller). *a*. Branch of an artery and its ramifications in the bands of the spongy structure of the penis.

Bloodvessels.—The bloodvessels of the penis are large in size, and serve to nourish as well as minister to the function of the organ. Having entered the cavernous mass, they ramify in the interstices of the trabecular structure, and end in the venous plexuses.

The *arteries* of the corpora cavernosa are offsets of the pudic, both at the root and along the body of the penis. Entering the cavernous structure, they divide into branches, which ramify in the trabeculae (fig. 96, a), becoming finer and finer, until they terminate in minute branches; these open into the veins in the intertrabecular spaces without the intervention of capillaries. Others of the terminal twigs end in tufts of short, slightly curved vessels—the *helicine* arteries of Müller (fig. 97), which project into the intertrabecular spaces, and are imbedded in the coat of the thin veins: these twisted vascular bodies have dilated extremities, and are continued by means of fine vessels into the venous spaces (Kölliker). The helicine arteries exist in greatest number at the posterior part of each corpus cavernosum.

Source of the arteries.

termination in dilated veins.

Helicine arteries.

Fig. 97.*



their ending.

The *veins* fill the interspaces of the areolar structure, and anastomose freely together to form venous plexuses. In these spaces the wall of the veins is very thin, because support is received from the surrounding fibrous structure. Into the large radicles of the veins the terminal branches of the arteries pour their contents; and the erectile condition of the corpus cavernosum is produced by the distension of those receptacles. By means of the apertures in the septum the veins of opposite sides communicate freely.

Veins are dilated and form plexuses.

Most of the veins of the corpus cavernosum issue along the upper and under aspects of the penis, to end in the dorsal vein and the prostatic plexus; but some escape at the crus penis, and join the pudic vein.

Ending of the veins.

Corpus spongiosum urethrae.—This constituent part of the penis surrounds the urethra, and forms the bulb behind and the glans penis in front (p. 614). The urethra is not enveloped equally on all sides by this tissue, for at the bulb only a thin stratum is above the canal. Posteriorly an offset of the corpus spongiosum is continued beyond the bulb around the urethra.

Spongy material of the penis

* A tuft of the twisted or helicine arteries (Müller). The dark shadowing around represents a vein incasing the bundle of vessels.

- its structure like cavernous. *Structure.*—The tissue of the corpus spongiosum is similar to that of the corpus cavernosum: thus it consists of a fibrous tunic enclosing a trabecular structure and bloodvessels.
- The fibrous case. The fibrous covering is less dense and strong than in the corpora cavernosa, and consists only of circular fibres. A piece projects inwards from it in the middle line, opposite the tube of the urethra: this is best marked for a short distance in front of the bulb; and it assists in dividing the bulb into two lobes. The trabecular bands are much finer, and more uniform in size than in the corpora cavernosa.
- Imperfect septum. *Bloodvessels.*—The arrangement of the bloodvessels in the erectile structure of the corpus spongiosum is similar to that in the corpora cavernosa; but the helicine terminations of the arteries are absent from the glans penis, where the veins form a very close and regular plexus.
- Bloodvessels. *The arteries* are derived from the pudic on each side:—they are, artery of the bulb and offsets of the dorsal artery; and they enter the spongy structure—the first behind, and the latter in front at the glans where they most abound. Kobelt describes another branch to the bulb at the upper aspect.
- Helicine arteries. *Most of the veins*, including those of the glans, end in the large dorsal vein of the penis, and some communicate with veins of the cavernous body: others issue from the bulb, and terminate in the pudic vein and the prostatic plexus.
- Source of arteries. *Nerves and lymphatics.*—The *nerves* of the penis are large and are supplied by both the spinal and sympathetic nerves. On the bulb of the urethra and the glans penis, they are furnished with Pacinian bodies (Fick). The superficial *lymphatics* join the inguinal glands; the deep accompany the veins beneath the arch of the pubes, to end in the lymphatic glands in the pelvis.
- Termination of the veins.
- Nerves.
- Lymphatics.

THE RECTUM.

- Rectum is smooth. The lower end of the large intestine, which is contained in the pelvis, is not sacculated like the colon, but is smooth on the surface.
- To prepare the gut. *Dissection.*—The rectum is to be washed out, and then distended with air; and the peritoneum and the loose fat are to be removed from it.
- Length; dimensions. The *rectum* is about eight inches in length, and its average diameter is that of the sigmoid flexure of the colon. Its size is uniform till towards the lower extremity, where it is dilated, particularly in old people; but at the aperture of

termination in the anus the gut is smaller than in any other part. The longitudinal bands of the colon are absent from this portion of the alimentary canal, and the fibres are spread over the surface.

Structure.—The rectum, like the rest of the large intestine, contains in its wall a peritoneal, a muscular, a mucous, and a submucous stratum. In it the muscular and the mucous layers have certain peculiarities that serve to distinguish this from other parts of the intestinal tube.

The *peritoneum* forms but an incomplete covering, and its arrangement is referred to in the description of the connections of the pelvic viscera (p. 609).

The *muscular* coat consists of two planes of fibres, as in the œsophagus, viz., a superficial or longitudinal, and a deep or circular : these fibres belong to the pale or unstriated kind.

The *longitudinal* fibres are continuous with those in the bands on the colon, but are here diffused to form a stratum around the gut.

The *circular* fibres describe arches around the intestine, and become thicker and stronger towards the anus, where they are collected into the band of the internal sphincter muscle.

The *mucous* coat is more moveable than that in the colon, and resembles in this respect the lining of the œsophagus ; it is also thicker and more vascular here than in the rest of the large intestine.

When the bowel is contracted the mucous lining is thrown into numerous accidental folds, some of which near the anus are longitudinal. But there are other three or four permanent folds, described by Mr. Houston, which are half an inch or less in depth, and contain some of the circular fibres of the gut.* The most constant of these is about three inches from the anus, on the front of the rectum, opposite the base of the bladder ; another is found on the right side of the intestine near the top ; and the third is on the left side, midway between the other two. Occasionally there is a fourth on the back of the rectum, about an inch from the anus. These folds will be seen by laying open the gut along the side, provided it is tolerably fresh.

The mucous membrane has the same general structure in the colon, but towards the anus the secretory apparatus gradually disappears.

* Vol. v. of the Dublin Hospital Reports, "Observations on the Mucous Membrane of the Rectum."

- Arteries.** *Bloodvessels.*—The *arteries* are supplied from three different sources:—They are, superior hæmorrhoidal, from the inferior mesenteric; middle hæmorrhoidal, from the internal iliac artery; and inferior hæmorrhoidal, from the internal pudic.
- arrangement of superior hæmorrhoidal.** All three sets anastomose on the lower end of the gut, and only the upper hæmorrhoidal, which is the largest, requires further notice. The branches of this artery (p. 625) about six in number pierce the muscular coat three inches from the anus, and descend between the mucous and muscular coats as far as the internal sphincter, where they end in loops like the veins, which join just within the anus, and form circular arterial rings.
- Veins are without valves.** The *veins* are deficient in valves, and communicate freely around the lower end of the gut. Above, they join the inferior mesenteric vein, and through it reach the vena portæ; and, posteriorly, they pour some blood into the internal iliac vein by branches corresponding with the middle hæmorrhoidal artery.
- Nerves.** *Nerves and lymphatics.*—The nerves for the intestine are obtained from the sympathetic, and those for the sphincter
- Lymphatics.** come from the spinal system. The lymphatics terminate in the chain of glands on the sacrum.

SECTION VI.

ANATOMY OF THE VISCERA OF THE FEMALE.

- Viscera in the pelvis.** In the female pelvis are the viscera common to both sexes, viz., the bladder and the urethra, with the rectum; and those special to the female, viz., the organs of generation.
- To remove the viscera,** *Dissection.*—The contents of the pelvis are to be removed together with the genital organs. In this proceeding the student should keep the scalpel close to the osseous boundary of the pelvic outlet, to avoid injuring the end of the rectum; and he should also detach the crus of the clitoris from the bone.
- and prepare them.** After the parts referred to are taken from the body, the rectum is to be separated from the uterus and the vagina, but the rest of the viscera may remain united until after the genital organs are examined.
- The bladder may be moderately distended, and the fat and the areolar tissue and vessels are to be removed from the viscera.

GENITAL ORGANS.

The genital organs consist of the following parts :—The mons Veneris and the external labia, the clitoris and the internal labia, and the vestibule with the meatus urinarius. Within the external labia is the aperture of the vagina, with the hymen or the remnant of it. Sometimes the term vulva or pudendum is applied to these parts as a whole.

Mons Veneris and labia pudendi.—In front of the pubes the integument is covered with hair, and is raised into a slight eminence,—mons Veneris, by a layer of subjacent fat.

Extending downwards from the prominence mentioned, are two folds of integument, the labia pudendi (labia majora), which correspond with the scrotum in the male. Above and below the labia are united, the points of junction being named commissures, but between them is an interval called rima. The labia decrease in thickness inferiorly ; they are covered externally with a few hairs, but are lined internally with a mucous membrane. In them is a dartoid tissue resembling that in the male scrotum. Within the lower commissure of the labia is a small thin transverse fold of integuments named fourchette, or frænulum ; and between this fold and the lower commissure is an interval—the fossa navicularis.

Clitoris and nymphæ.—Beneath the upper commissure of the labia majora is the projection of the clitoris, with the nymphæ or smaller labia descending from it.

Dissection.—To see the clitoris, the integuments forming the upper commissure must be removed ; and, after the body of the organ has been laid bare, the crura are to be followed outwards one to each side.

The clitoris is a small erectile body, and is the representative of the penis. It has the same anatomy as that organ, with the exception that the urethra and the spongy enveloping substance are not continued below it. Its anterior extremity is terminated by a rounded part or glans, and is covered by a fold of the skin corresponding with the prepuce of the male. In its composition this organ resembles the penis in the following particulars :—it consists of corpora cavernosa, which are attached by crura (one on each side) to the pubic arch, and are then blended to form one body with an imperfect pectiniform septum ; and further, it possesses a corpus spongiosum, but this structure is limited to the glans clitoridis.

Structure.—The outer casing and the septum are alike in

External
organs.

Mons
Veneris.

Labia ma-
jora.

Fourchette
and fossa.

Clitoris :

dissection
to see it.

It is like the
penis ;

has a glans
and pre-
puce,

corpora
cavernosa,

and erectile
tissue.

Labia minora descend from prepuce.

both penis and clitoris ; and in the interior of the clitoris is an erectile tissue, like that in the male organ (p. 642).

The *nymphæ* (labia minora) are two folds of mucous membrane that descend from the end of the clitoris, one on each side of the orifice of the vagina : they are continuous above with the preputial covering of the clitoris, and extend down about one inch and a half. The inner surface is continuous with the lining of the vestibular space and vagina ; and the outer, with the covering of the external labium. Bloodvessels are contained in each fold.

Vestibule.

Vestibule and orifice of the urethra.—Within the nymphæ, between the clitoris above and the vagina below, is an angular interval, about one inch and a half deep, which is called the vestibule. In the middle line of the vestibular space is the round orifice of the urethra, which is placed in an eminence about one inch below the clitoris, and near the aperture of the vagina.

Opening of the urethra.

Aperture of the vagina.

Orifice of the vagina and the hymen.—The aperture of the vagina is close below the meatus urinarius, and varies much in size. In the child and in the virgin state it is partly closed below by a thin semilunar fold of mucous membrane named the hymen. After the destruction of that membrane small irregularly-shaped projections, carunculæ myrtiformes, exist around the opening of the vagina.

Hymen and caruncule.

Mucous layer over genitals. Its papillæ, epithelium, and glands.

Mucous membrane.—The mucous covering of the external genitals is furnished throughout with papillæ, but these are largest on the labia minora and the clitoris. Its epithelium is laminar. Besides sebaceous glands on the labia majora and minora, other branched mucous glands open on the surface.

GENERATIVE ORGANS.

The generative organs are the uterus and the vagina, and the ovaries with the Fallopian tubes.

Separate vagina and uterus.

Dissection.—The viscera are now to be separated, so that the bladder and the urethra may be together, and the vagina and the uterus remain united. The bladder is to be set aside for subsequent use, and the other organs are to be learnt first. The surface of the vagina and lower part of the uterus should be cleaned, but the peritoneal investment of the latter is to be left untouched for the present.

THE VAGINA.

Vagina: extent

The vagina is a dilatable tube, which is connected with the uterus at one end, and terminates in the vulva at the other. It has a curved course between the two points mentioned :

and the anterior and posterior surfaces of the tube are not equal in length, for the former measures about four inches, and the latter is about five or six in extent. and curved course.

In the body the vagina is flattened from above downwards, so that the opposite surfaces may be in contact, but the upper end is rounded where it is joined to the uterus. Its size varies at different spots:—thus the external orifice which is surrounded by the constrictor vaginæ muscle is the narrowest part; the middle portion is the largest; and the upper end is intermediate in dimensions between the other two. Form and size.

After the vagina has been laid open by an incision along the upper wall, the position of the uterus in that wall instead of the extremity may be remarked; and further, the tube may be seen to extend higher on the posterior than the anterior aspect of the cervix uteri. On the inner surface, towards the lower part, is a slight longitudinal ridge both in front and behind, named columns of the vagina. Before the tissue of the vagina has been distended, other transverse ridges or rugæ may be seen passing between the columns. Interior has columns and rugæ.

The wall of the vagina is thicker anteriorly, where the urethra is situate, than at any other part of the canal. Wall.

Structure.—The vaginal wall is formed by a spongy erectile tissue, which is covered externally by a muscular layer, and lined by mucous membrane. At its lower end the tube is surrounded by a band of the fibres of the sphincter vaginæ muscle (p. 473). An erectile structure in the wall.

The erectile tissue is more abundant at the ends than the middle of the vagina, and is greatest in quantity below where it gives increased thickness to the wall. Erectile tissue

Two masses of the erectile tissue, one on each side of the opening of the vagina, have been described as the *semi-bulbs* by Taylor, and as the *bulbi-vestibuli* by Kobelt (fig. 98, a). These are elongated masses of plexiform veins, enclosed in fibrous membrane; they are about an inch in length, and are situate one on each side of the vestibule, where they are covered on the outer side by the constrictor vaginæ (b). At its upper part each is pointed, and communicates with the vessels of the clitoris: whilst at the posterior rounded part it joins the venous plexus of the vagina. These bodies are supposed by Kobelt to be the homologue of the bulb of the corpus spongiosum urethræ in the male; but the answering part is split in the female, instead of forming one piece in the middle line, and each lateral half is thrust aside towards the crus clitoridis by the large aperture of the vagina. forms semi-bulbs, which correspond to the bulb of the male.

Mucous
membrane
of the
vagina.

The *mucous membrane* is continued through the lower aperture to join the integument on the labia majora, and through the os uteri, at the opposite end, to the interior of the uterus. Many muciparous follicles abound on the sur-

Fig. 98.*



face, but these are in greatest abundance at the upper part. The papillæ on the surface are conical and filiform in shape. A laminar *epithelium* gives a covering to the membrane.

Muscular
stratum.

The *muscular layer* is outside the erectile structure, and consists of longitudinal fibres. Some reach all along the vagina; others, and these are the strongest, only as far upwards as the recto-vesical fascia, to which they are attached on each side. Above they end in the superficial layer of the uterus and in the peritoneum, but below in the subdermic tissue.

Arteries.
Veins are
plexiform.

Bloodvessels and nerves.—The *arteries* are derived from the visceral branches of the internal iliac. The *veins*, corresponding with the arteries, form a plexus around the vagina, as well as in the external or genital organs, and open into the internal iliac vein. For a description of the nerves see page 630.

* Veins and venous plexuses of the genital organs and opening of the vagina (Kobelt).—*a.* Semi-bulbs or bulbus vestibuli. *c.* Venous plexus continuous with veins of the clitoris (*pars intermedia*, Kobelt). *f.* Glans clitoridis. *h.* Dorsal vein of the clitoris. *l.* Obturator vein. *b.* Sphincter vaginae muscle.

Glands of Bartholine.—On the outer part of the vagina, near the aperture at the lower end, are two small yellowish glandular bodies, one on each side, which represent Cowper's glands in the male. Each is a branched mucous gland, about as large as a small bean. Its duct is directed forwards to open on the inner aspect of the nympha of the same side. The duct resembles that of Cowper's gland in its ramifications and structure (p 468). Two glands analogous to Cowper's.

THE UTERUS.

The uterus or womb is formed chiefly of unstriped muscular fibres. Its office is to receive the ovum and retain for a fixed period the developing fetus. Uterus.

This viscus in the virgin state is pear-shaped, or rather triangular in consequence of the body being flattened (fig. 99), and presents inferiorly a rounded narrow part or neck. Deviations from the standard shape are seen in the infant, where the neck is larger than the body; and in the aged female, in whom there is little separation between the same two parts. Form; how changed.

Commonly the uterus measures about three inches in length, two in breadth at the upper part, and an inch in greatest thickness. Its weight varies from an ounce to an ounce and a half. But after gestation its size and volume exceed always the measurement here given. Dimensions.

The *upper* end is convex (fig. 99, *a*), and is covered by peritoneum: the term *fundus* is applied to the part of the organ above the attachment of the Fallopian tubes. Upper end.

The *lower* end is small and rounded, and in it is a transverse aperture of communication between the uterus and the vagina (*d*), named *os uteri* (*os tinæ*): its margins or lips (labia) are smooth, and anterior and posterior in situation, but the hinder one is the longest. Towards the lower part the uterus is constricted (fig. 99, *c*), and this diminished portion is called the neck of the uterus (*cervix uteri*); it is surrounded by the vagina, and is covered by this tube to a greater extent behind than in front. The neck is about half an inch in length, and gradually tapers towards the extremity. The lower end is small; has an opening. Neck.

The *body*, or the intervening part of the uterus, is more convex posteriorly than anteriorly, and decreases in size down to the neck. It is covered on both aspects by the peritoneum, except about half an inch at the lower part in front, where it is connected to the bladder. To each side, which is straight, the parts contained in the broad fold of Body. Sides and attached parts.

the peritoneum are attached ;—viz., the Fallopian tube at the top (*s*), the round ligament rather below and before it, and the ovary (*o*), and its ligament (*p*) below and behind the others.

Open the
uterus.

Dissection.—To examine the interior of the uterus, a cut is to be made along the anterior wall from the fundus to the os uteri ; and then some of the tissue is to be taken away on each side of the middle line to show the contained cavity.

Its thick-
ness.

The *thickness* of the uterine wall is greatest opposite the middle of the body. It is greater at the centre than at the angles of the fundus (fig. 99), the wall becoming thinner towards the attachment of the Fallopian tubes.

In the
interior

Interior of the uterus (fig. 99).—Within the uterus is a

Fig. 99.*



small space, which is divided artificially into two—one of the body, another of the neck of the organ.

is a trian-
gular space
in the body,

The space occupying the body of the viscus is triangular in form, and is larger than the other. Its base is at the fundus of the uterus, where it is convex towards the cavity, and the angles are prolonged towards the Fallopian tubes. The apex is directed downwards, and joins the cavity in the cervix by a narrowed circular part, *isthmus* (os uteri internum), which may be narrower than the opening of the uterus into the vagina.

which is
narrowed
below ;

* Cavity of the uterus and vagina shown, with a posterior view of the broad ligament.—*a*. Fundus uteri. *b*. Body of the uterine cavity. *c*. Cervix with the arbor vitæ. *d*. Mouth of the uterus. *e*. Cavity of the vagina. *f*. Broad ligament of the uterus. *g*. Fallopian tube:—*i*. marking the inner opening, and *t* the outer or corpus fimbriatum. *o*. Ovary, and *p* ligament of the ovary.

The space within the neck terminates inferiorly at the os uteri (fig. 99, c), and it is continuous above, as before said, with the space within the body. It is larger at the middle than at either end, being spindle-shaped, and is somewhat flattened like the cavity of the body. Along both the anterior and the posterior wall is a longitudinal ridge, and other ridges (*rugæ*) are directed obliquely from these on each side: this appearance has been named *arbor vitæ uterinus*. In the intervals between the *rugæ* are some mucous follicles, which sometimes become filled and distended with fluid, and give rise to the rounded clear sacs named the *ovula* of *Naboth*.

and a spindle-shaped space in the neck.

In the neck are ridges or the arbor vitæ.

STRUCTURE.—The dense wall of the uterus is composed of layers of unstriated muscular fibre, intermixed with dense areolar and elastic tissues, and large bloodvessels. On the exterior is the peritoneum, and lining the interior is a thin mucous membrane.

Uterus is a muscular organ.

The *muscular fibres* can be demonstrated at the full period of gestation to form three strata in the wall of the uterus, viz. external, internal, and middle. The *external* layer contains fibres which are mostly transverse; but at the fundus and sides they are oblique, and are more marked than along the middle of the organ. At the sides the fibres converge towards the broad ligament; some are inserted into that membrane; whilst others are prolonged on the Fallopian tube, the round ligament, and the ligament of the ovary. The *internal* fibres describe circles around the openings of the Fallopian tubes, and spread from these apertures till they meet at the middle line. At the neck of the uterus they become transverse in direction. The *middle* or intervening set of fibres are more indistinct than the others, and have a less determinate direction.

There are three strata: external,

internal, and middle.

The *mucous* lining is continued into the vagina at one end of the uterus, and into the Fallopian tubes at the other. In the interior of the uterus it is of a reddish white colour, and is thin, smooth, and adherent, but without papillæ. Like the mucous membrane of the intestine, it possesses tubular glands, which may be either straight and simple, or may be twisted or branched; the minute apertures of these are scattered over the surface. In the cervix uteri, between the *rugæ*, mucous follicles and glands are collected, and near the outer opening are filiform papillæ.

Mucous lining is

covered with glands.

Follicles in the neck.

The *epithelial* covering of the mucous membrane consists of a single layer of cells, which is columnar and ciliated throughout the cavity of the uterus.

Epithelium.

The *bloodvessels* of the uterus are large and tortuous, and

Vessels are large.

the veins occupy canals in the uterine substance, in which they communicate freely together. The *arteries* are furnished from the uterine and ovarian branches. The *veins* correspond with the arteries. The *nerves* are derived from the sympathetic, and are very small in proportion to the size of the uterus. External to the uterus they are not enlarged in pregnancy. (Beck.)*

Round ligament of the uterus.—This firm cord supports the uterus, and is contained partly in the broad ligament, and partly in the inguinal canal (p. 496). It is about four or five inches in length, and is attached to the upper part of the uterus close below, and anterior to the Fallopian tube. A process of the peritoneum accompanies the part of the cord in the inguinal canal, and remains pervious sometimes for a short distance.

The ligament is composed of unstriated muscular fibres, derived from the uterus, together with vessels and areolar tissue. It is said to possess some transversely striated muscular fibres.

OVARIES AND FALLOPIAN TUBES.

Ovary: position. OVARY.—The ovaries are two bodies, corresponding with the testes of the male. They are contained in the broad ligaments of the uterus, one in each, and at the posterior aspect.

Form and colour; dimensions. Each ovary is of an elongated form, and somewhat flattened from above down. It is of a whitish colour, with either a smooth or a scarred surface. Its volume is variable; but in the virgin state it is about one inch and a half in length, half that size in width, and a third in thickness.

and weight. Its weight is nearly a quarter of an ounce.

Connections. The ovary is connected with the broad ligament by its anterior margin, where the vessels enter the stroma. Its outer end is rounded and is connected with one of the fimbriæ at the mouth of the Fallopian tube. The inner extremity is narrowed, and is attached to the side of the uterus by a fibrous cord,—the ligament of the ovary, which is placed below the level of the Fallopian tube and the round ligament.

Glandular in structure. *Structure.*—The ovary consists of a fibrous and vascular stroma of areolar tissue, which contains small vesicles or ovisacs, named Graafian, and is enclosed within a fibrous tunic. The peritoneum surrounds the whole except at the attached margin.

* See a Paper in the Philosophical Transactions for 1846.

The special *fibrous* coat (*tunica albuginea*) is of some thickness and of a whitish colour, whence its name, and is adherent to the contained stroma. Sometimes a yellow spot (*corpus luteum*) or some fibrous cicatrices may be seen in this covering.

A fibrous coat surrounds stroma.

The ovisacs or the *Graafian vesicles* are small round transparent bodies, and are from thirty to fifty or one hundred or more in number in each ovary till after the child-bearing period. They vary in size from a pin's head to a pea, and are scattered through the stroma of the ovary. They are largest in size towards the circumference of the organ, and sometimes they may be seen projecting through the fibrous coat.

In the stroma are small vesicles.

Size and number.

Each consists of a transparent coat with a fluid inside.

Coat;

The coat of the vesicle named *ovi-capsule* (*tunica fibrosa*), is formed of fine areolar tissue, and is united to the stroma of the ovary by a network of bloodvessels, which ramifies in the wall. Lining it is a laminar series of nucleated cells—the *membrana granulosa* of Baer, which is thickened at one spot on the side towards the ovary, and forms a prominence, the germinal eminence, around the ovum. The fluid in the interior is transparent and albuminous; and in it is suspended the minute vesicular ovum, together with molecular granules.

contents.

When the Graafian vesicle is matured it bursts on the surface of the ovary, and the contained ovum escapes into the Fallopian tube. After the shedding of the ovum the ruptured vesicle gives origin to a yellow substance, *corpus luteum*, which finally changes into a cicatrix.

Shedding of an ovum and corpus luteum.

Bloodvessels and nerves.—The ovarian artery pierces the ovary at the anterior or attached border, and its branches run in zigzag lines through the stroma, to which and the Graafian follicles they are distributed. The veins begin in the follicles and the texture of the ovary, and after escaping from its substance, form a plexus (*pampiniform*) near the ovary, and within the fold of the broad ligament. The nerves are derived from the sympathetic on the ovarian and uterine vessels.

Artery; veins; nerves.

Appendage to the ovary.—(Parovarium, Organ of Rosenmüller.) On holding up the broad ligament of the uterus to the light, a collection of small tortuous tubules will be seen between the ovary and the Fallopian tube. This mass is the remnant of the Wolffian body of the fetus; and it is about one inch broad with its base to the Fallopian tube, and apex to the attached part of the ovary. The small

Appendage to ovary. Situation. Form.

- Structure. tubes are quite separate from the surrounding parts, and are about twelve to twenty in number. Each is a closed fibrous capsule with a clear fluid within, and a lining of one layer of columnar epithelium.
- Fallopian tubes. FALLOPIAN TUBES.—These tubes convey the ova from the ovaries to the uterus, and correspond in their office with the vasa deferentia in the male.
- Length, and form. The tubes are two in number, one on each side. Each is about four inches in length. Cord-like at the inner end, where it is attached to the upper part of the uterus, it increases in size towards the outer end, and terminates in a wide extremity, like the mouth of a trumpet. This dilated end is fringed and named *corpus fimbriatum*; and the serrations of its circumference are called fimbriæ. When the fimbriated end is floated out in water, one of the processes may be seen to be connected with the outer end of the ovary. In the centre of the fimbriæ is a groove leading to the orifice of the Fallopian tube.
- It is dilated externally, and fimbriated. On opening the tube with care, the size of the contained space, and its small aperture into the uterus can be observed. Its canal varies in size at different spots;—the narrowest part is at the orifice into the uterus, where it scarcely gives passage to a fine bristle; towards the outer end it increases a little, but it is rather diminished in diameter at the outer aperture.
- Size of the tube is least at the ends. *Structure*.—This excretory tube has the same structure as the uterus with which it is connected, viz. a muscular tunic, covered externally by peritoneum, and lined by mucous membrane.
- A muscular structure. The muscular coat is formed of an external or longitudinal, and an internal or circular layer; both these are continuous with similar strata in the wall of the uterus.
- Fibres prolonged from uterus. The mucous membrane forms some longitudinal folds, particularly at the outer end. At the inner extremity of the canal it is continued into the mucous lining of the uterus, but at the outer end it joins the peritoneal covering. An elongated ciliated *epithelium* covers the surface, as in the uterus.
- Mucous coat is continuous with peritoneum. The bloodvessels and nerves are furnished from those supplied to the uterus and the ovary.
- Vessels.

THE BLADDER, URETHRA, AND RECTUM.

Anatomy given before.

BLADDER.—The peculiarities in the form and size of the female bladder have been noticed in the description of the

connections of the viscera of the female pelvis (p. 619). For a notice of its structure, the anatomy of the male bladder is to be referred to (p. 635).

Dissection.—To prepare the bladder, distend it with air, and remove the peritoneal covering and the loose tissue from the muscular fibres. After the external anatomy of the bladder and urethra have been learnt, both the receptacle for the urine and its excretory tube are to be slit open along the upper part.

URETHRA.—The length and the connections of this excretory tube are given in page 619.

The average diameter of the tube is rather more than a quarter of an inch, and the canal is enlarged and funnel-shaped towards the neck of the bladder. Near the external aperture there is a hollow in the floor of the tube. In consequence of not being surrounded by resistant structures, the female urethra is much more dilatable than the corresponding passage in the male.

Structure.—This tube, like the urethra of the male, consists of a mucous coat, which is enveloped by a plexus of bloodvessels, and by muscular fibre.

The muscular coat extends the whole length of the urethra. Its fibres are circular, and continuous behind with the middle layer of the bladder. This covering is placed between the constrictor urethræ and the submucous layer, as in the male (p. 639); and the part nearest the bladder will correspond with the prostatic enlargement in the other sex.

The *mucous* coat is pale except near the outer orifice. It is marked by longitudinal folds; and one of these, in the floor of the canal, resembles the median crest in the male urethra (p. 639). Around the outer orifice are some mucous *follicles*; and towards the inner end are some mucous *glands*, whose apertures are arranged in lines between the folds of the membrane, and are turned towards the bladder. A *laminar epithelium* is spread over the surface, and beneath it are deeper conical cells as in the bladder.

A *submucous* stratum of longitudinal elastic and muscular tissues lies close to the mucous membrane as in the male.

RECTUM.—The structure of the rectum is similar in the two sexes; and the student may use the description in the Section on the anatomy of the viscera of the male pelvis (p. 644).

Dissection.—The rectum may be prepared for examination by distending it with air or tow, and removing the peritoneal covering and the areolar tissue from its surface.

Preparation of it.

Length of urethra.

Size;

it can be much dilated.

Tube like that in the male.

Muscular coat of circular fibres.

Mucous coat.

A fold in floor.

Follicles and glands.

Epithelium.

Submucous tissue.

Rectum like that of the male.

Preparation of rectum.

SECTION VII.

INTERNAL MUSCLES AND THE LIGAMENTS OF THE PELVIS.

Two muscles. MUSCLES.—The two following muscles, pyriformis and obturator internus, have their origin within the cavity of the pelvis,

Pyriformis. The PYRIFORMIS MUSCLE is wide and fleshy within the pelvis, and is directed outwards through the great sacro-sciatic notch to the great trochanter of the femur. The muscle has received its name from its form.

Origin in the pelvis. In the pelvis the pyriformis *arises* by three slips from the second, third, and fourth pieces of the sacrum, both between, and external to the anterior apertures; as it passes from the pelvis, it takes origin also from the surface of the hip bone forming the upper part of the large sacro-sciatic notch, and from the great sacro-sciatic ligament. From this origin the

Insertion. fibres converge to the tendon of *insertion* into the trochanter. (See Dissection of the Buttock.)

Its connections with parts around. The anterior surface is in contact with the rectum, but more on the left than the right side; with the sacral plexus, and with the sciatic and pudic branches of the internal iliac vessels. Whilst the opposite surface rests on the sacrum, and is covered by the great gluteal muscle outside the pelvis. The upper border is near the hip bone, the gluteal vessels and the superior gluteal nerve being between; and the lower border is contiguous to the coccygeus muscle, only the sciatic and pudic vessels and nerves intervening.

Obturator muscle. The OBTURATOR INTERNUS MUSCLE, like the preceding, has its origin in the pelvis, and its insertion out of the cavity at the great trochanter of the femur; but the part outside is almost parallel in direction with that inside the pelvis.

is bent over pelvis. The muscle *arises* by a broad fleshy attachment from the inner surface of the obturator membrane, except a small part below, and from the fibrous arch bounding the canal containing the obturator vessels and nerves; slightly from the surface of bone internal to the membrane; and largely from the smooth inclined surface of the pelvis behind the thyroid hole,—reaching upwards to the brim, downwards to the outlet, and backwards to the great sacro-sciatic notch of the pelvis, though opposite the small sacro-sciatic notch a thin layer of fat separates the fleshy fibres from the bone. The fibres are directed backwards and somewhat downwards, and end in four or five tendinous pieces, which turn over the

Arching of its tendons

sharp pulley-like surface at the back of the hip bone corresponding with the small sacro-sciatic notch. Outside the pelvis the tendons blend into one, which is inserted into the great trochanter.

over the hipbone.
Insertion.

The pelvic portion of the muscle is in contact by one surface with the wall of the pelvis and the obturator membrane; and by the other surface with the fascia lining the pelvic wall, and towards its lower border with the pudic vessels and nerve. Above the level of the levator ani, viz. a line from the lower part of the symphysis pubis to the ischial spine, the muscle corresponds with the cavity of the pelvis, but below that line, with the ischio-rectal fossa.

Part of muscle is in pelvic cavity,
part in perineal space.

COCYGEUS MUSCLE.—The position and the connections of this muscle may be now studied in the interior of the pelvis. The muscle is described at p. 605.

Coccygeus muscle.

The several bones of the pelvis have the following articulations with one another. The sacrum is joined by its base to the last lumbar vertebra, and by its apex to the coccyx. Laterally this central bone is united with the two innominate bones. And the innominate bones are connected together in front, as well as to the sacrum and the spinal column posteriorly.

Outline of the articulations.

SACRO-VERTEBRAL ARTICULATION.—The base of the sacrum is articulated with the last lumbar vertebra by ligaments similar to those uniting one vertebra to another (p. 407); and by one special ligament—the sacro-vertebral.

Union of sacrum with last vertebra.

Dissection.—For the best manner of bringing these different ligaments into view, the dissector must consult the directions already given for the dissection of the ligaments of the vertebræ (p. 408).

Dissection.

The common ligaments between the bodies of the two bones are an anterior and a posterior, with an intervening fibro-cartilaginous substance. Between the neural arches are the ligamenta subflava; between the spines, the supra and interspinous bands; and between the articular processes are capsular ligaments and synovial membranes.

By ligaments as in the vertebræ.

The sacro-vertebral or intertransverse ligament (fig. 100¹) is a strong bundle of fibres, which reaches from the under surface of the tip of the transverse process of the last lumbar vertebra to the lateral part of the base of the sacrum (transverse process). Widening as it descends, the ligament joins the fibres in front of the lateral articulation between the sacrum and the innominate bone.

and by special band, sacro-vertebral.

SACRO-COCYGEAL ARTICULATION.—The bodies of the sacrum and coccyx are united by a fibro-cartilage, and by

Union of sacrum and coccyx.

SECTION VII.

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Two muscles. MUSCLES.—The two following muscles, *pyriformis* and *obturator internus*, have their origin within the cavity of the pelvis.

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Origin in the pelvis. In the pelvis the *pyriformis* arises by three slips from the second, third, and fourth pieces of the sacrum, both between, and external to the anterior apertures; as it passes from the pelvis, it takes origin also from the surface of the hip bone forming the upper part of the large sacro-sciatic notch, and from the great sacro-sciatic ligament. From this origin the

Insertion. fibres converge to the tendon of insertion into the trochanter. (See Dissection of the Buttock.)

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Obturator muscle The *OBTURATOR INTERNUS* MUSCLE, like the preceding, has its origin in the pelvis, and its insertion out of the cavity at the great trochanter of the femur; but the part outside is almost parallel in direction with that inside the pelvis.

is bent over pelvis. The muscle arises by a broad fleshy attachment from the inner surface of the obturator membrane, except a small part below, and from the fibrous arch bounding the canal containing the obturator vessels and nerves; slightly from the surface of bone internal to the membrane; and largely from the smooth inclined surface of the pelvis behind the thyroid hole,—reaching upwards to the brim, downwards to the outlet, and backwards to the great sacro-sciatic notch of the pelvis, though opposite the small sacro-sciatic notch a thin layer of fat separates the fleshy fibres from the bone. The fibres are directed backwards and somewhat downwards, and end in four or five tendinous pieces, which turn over the

Arching of its tendons

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Insertion.

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Part of
muscle is
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Coccygeus
muscle.

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Outline of
the articu-
lations.

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sacrum with
last verte-
bra.

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Dissection.

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By special
band, sacro-
vertebral.

SACRO-COCYGEAL ARTICULATION.—The bodies of the sacrum and coccyx are united by a fibro-cartilage, and by

Union of
sacrum and
coccyx.

an anterior and a posterior common ligament. And there is a separate articulation for the cornua of the bones.

Dissection. *Dissection.*—Little dissection is necessary for these ligaments. When the areolar tissue has been removed altogether from the bones, the ligaments will be apparent.

An anterior and The *anterior ligament* (sacro-coccygeal) consists of a few fibres that pass between the bones in front of the fibro-cartilage.

a posterior ligament, The *posterior ligament* is wide at its attachment to the lower margin of the orifice of the sacral canal, but narrows as it descends to be inserted into the coccyx.

Fig. 100.*

and a fibro-cartilage.

Union of the cornua.



Union of bones of the coccyx.

Union between the sacrum and hip bone.

To dissect the ligaments.

The *fibro-cartilage* resembles that between the vertebræ, and is attached to the surfaces of the bones.

Articulation of the cornua.

—The cornua of the first piece of the coccyx articulate with the cornua of the last sacral vertebra by ligamentous bands, instead of joints as in the articular processes of the other vertebræ.

UNION OF THE BONES OF THE COCCYX.—Whilst the

several pieces of the coccyx remain separate, their centres are connected together by *anterior* and *posterior* bands, and by intervening thin *fibro-cartilages*. But in the male adult the bones are generally joined by ossific matter.

SACRO-ILIAC ARTICULATION.—The irregular surfaces by which the sacrum and the innominate bone articulate, are united by cartilage, and maintained in contact by anterior and posterior sacro-iliac ligaments. Inferiorly the bones are further connected, without being in contact, by the strong sacro-sciatic ligaments.

Dissection.—To see the posterior ligaments, the mass of muscle at the back of the sacrum is to be removed on the side on which the innominate bone remains; and the anterior

* Ligaments of the pelvis and hip joint.—1. Sacro-vertebral. 2. Ilio-vertebral or ilio-lumbar. 7. Anterior sacro-iliac. 8. Symphysis pubis. 9. Subpubic ligament. 10. Obturator ligament or membrane. 11. Hip joint capsule. 12. Ilio-femoral band.

bands will be visible on the removal of some areolar tissue. The great sacro-sciatic ligament is dissected with the lower limb; and the small ligament will be brought into view by removing the coccygeus.

The *anterior sacro-iliac* ligament (fig. 100,⁷) consists of a few thin scattered fibres, which are attached to the sacrum and the hip bone near their articular surfaces. Anterior ligament.

The *posterior ligaments* (sacro-iliac) are much stronger than the anterior, and the fibres are collected into bundles. These ligaments pass from the rough inner surface at the posterior extremity of the innominate bone to the first two pieces of the sacrum. One bundle, which is distinct from the others, and more superficial, is named the *oblique or long posterior* ligament; it is attached to the posterior upper iliac spinous process, and descends almost vertically to the third piece of the sacrum. Posterior ligaments;
one more distinct than the rest.

Articular cartilage.—Between the irregular surfaces of the bone in this articulation (sacro-iliac symphysis) is a thin uneven layer of cartilage. In it there is sometimes a hollow with irregular surfaces like that in the cartilage of the symphysis pubis. On separating the bones after the other ligaments are examined, the cartilage may be detached with a knife. Articular cartilage.

Two *sacro-sciatic ligaments* pass from the lateral part of the sacrum and coccyx to the ischial spine and tuberosity of the hip bone, across the space between the bones at the back of the pelvis. The ligaments are named large and small.

The *large* ligament (fig. 101,⁴) reaches from the back of the hip bone, and from the side of the sacrum and coccyx to the ischial tuberosity; but it may have been cut in the dissection of the gluteal region, with which it is examined.

The *small* ligament (fig. 101,⁵) is attached internally by a wide part to the border of the sacrum and coccyx, where it is united with the origin of the preceding ligament. The

Fig. 101.*



Sacro-sciatic ligaments are two;

large;

* Great sacro-sciatic ligaments.—4. Large or posterior ligament. 5. Small or anterior ligament.

attachments and connections. fibres are directed outwards to the ischial spine of the hip bone, and are inserted into it by a narrowed part. Its pelvic surface is covered by the coccygeus muscle, and its opposite surface is in contact with the great sacro-sciatic ligament. Above this ligament, between it and the bone, is the large sacro-sciatic foramen; and below it is the small foramen of the same name.

Apertures formed by them. By their position these ligaments convert into two apertures or foramina (sacro-sciatic), the large sacro-sciatic excavation in the dried bones: these openings, and the parts they give passage to, are described in the dissection of the buttock.

Special ligaments of hip bones. LIGAMENTS OF THE INNOMINATE BONES.—The innominate bones are united in front, at the pubic symphysis, by an interposed cartilage and special ligaments; and behind, each is connected with the transverse process of the last lumbar vertebra by a special band (ilio-lumbar). In the centre of the bone is a membranous structure closing the thyroid aperture.

Ilio-lumbar. The *ilio-lumbar* or *ilio-vertebral ligament* is triangular in form (fig. 100, ²), and is divided into fasciculi. Internally it is attached to the tip of the transverse process of the last lumbar vertebra; externally the fibres spread out, and are inserted into the iliac crest, opposite the posterior part of the iliac fossa on the inner aspect of the hip bone. To the upper border of this ligament the fascia lumborum is attached. Its posterior surface is covered by the quadratus lumborum, and its anterior by the iliacus muscle.

fixes the bone behind. The *obturator membrane* closes almost entirely the thyroid foramen (fig. 100, ¹⁰), and is composed of fibres crossing in different directions. It is attached at the outer and upper part to the bony margin of the foramen, except above where the obturator vessels lie; and it is connected towards the inner part to the pelvic surface of the bone. The surfaces of the ligament give attachment to the obturator muscles. Branches of the obturator artery and nerve perforate it.

Union at the pubes. PUBIC ARTICULATION (symphysis pubis).—The oval pubic surfaces of the hip bones are united by cartilage, and by fibres in front of, and above the bones. They are also connected by a strong subpubic ligament.

Anterior band. The *anterior pubic ligament* (fig. 800, ⁵) is very strong and is formed of different layers of fibres. The superficial are oblique, and cross one another, uniting with the aponeurosis of the external oblique muscle of the abdomen; but the deeper fibres are transverse between the surfaces of the bones. Some of the deeper fibres contain cartilage cells. There is not any posterior band; but beneath the periosteum

there are a few scattered fibro-cartilaginous fibres, as in front, in contact with the cartilage.

The *superior* ligamentous fibres are placed as their name expresses. Upper band.

The *subpubic ligament* (ligam. arcuatum) is a strong triangularly-shaped band below the symphysis (fig. 100, ⁹), and occupies the upper part of the pubic arch. Its fibres curve downwards, and are attached on each side to the bone. The apex of the ligament touches the articular cartilage, and the base is turned towards the membranous part of the urethra and the muscle around it. Subpubic ligament.

Cartilage.—This structure will be best seen by opening the articulation behind. A transverse section will also show the disposition of the anterior ligament of the articulation. Cartilage, how seen;

The cartilage joins the bones in front, and is firmly fixed to the ridged bony surfaces of the symphysis. It is larger above than below, and is generally as thick again before as behind. Variations in size depend on the shape of the bones, and not on difference in sex. disposition in the symphysis.

Towards the posterior part of the cartilaginous mass a hollow or narrow fissure is excavated with uneven walls and a synovial-looking fluid;* and a fibrous structure with large interspersed compound cells is to be recognised in its wall. This space varies in size. It extends usually the whole depth of the cartilage. In some bodies it reaches through the whole thickness from before back so as to divide the mass into two collateral pieces; in others it projects through only a half or a third of the cartilage. Hollow in it. Variations in size.

* This hollow is said to increase in pregnancy.



VEINS OF THE ABDOMEN.

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TABLE OF THE VEINS OF THE ABDOMEN.

[illegible]

TABLE OF THE SPINAL NERVES IN THE ABDOMEN.

LUMBAR SPINAL NERVES di- vide into	Posterior branches	Internal . .	Muscular.
		external	{ Muscular cutaneous.
		Ilio-hypo- gastric.	{ Cutaneous of the ilium hypogastric branch.
		Ilio-inguinal	{ To integuments of the groin.
		external cu- taneous	{ To integuments of the thigh.
	Anterior branches; of these the four first end in the LUMBAR PLEXUS,* which supplies	genito-cru- ral . .	{ Genital branch crural branch.
		anterior cru- ral . .	{ Branches inside the pelvis . . { To the iliacus muscle. Branches outside the pelvis . . { To the femoral artery. are noticed in the thigh.
		obturator .	Accessory . . . { Other offsets are described in the thigh.
SACRAL SPINAL NERVES di- vide into	Posterior branches unite together and give off . . .		Muscular and cutaneous filaments.
		Branches in- side the pelvis . .	{ Visceral to levator ani to obturator in- ternus to the pyriformis
	The anterior branch- es of the four su- perior unite with the lumbo-sacral in the SACRAL PLEX- US,† and furnish .		{ Inferior hæmor- rhoidal superficial peri- neal—(anterior and posterior) muscular to the bulb dorsal of the pe- nis.
		branches outside the pelvis . .	{ inferior hæmor- rhoidal (some- times).
			{ To the superior gemellus to the inferior ge- mellus and the quadratus articular small sciatic great sciatic
			{ these are de- scribed in the thigh.

* The lumbo-sacral gives off the superior gluteal nerve.

† The other sacral nerves are described at p. 627.



NERVES OF THE ABDOMEN.

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TABLE OF THE SYMPATHETIC NERVE OF THE ABDOMEN.

SOLAR PLEXUS* or prevertebral centre of the abdomen, furnishes the following plexuses:	Diaphragmatic	Coronary plexus	
	coeliac	hepatic	{ Pyloric right gastro-epiploic pancreat.-duodenal cystic.
		splenic	{ Left gastro-epiploic pancreatic.
	superior mesenteric.	Offsets to small and large intestine.	
	suprarenal		
	renal	Spermatic plexus, filaments to the.	
	aortic	Hypogastric.	
	spermatic		
	inferior mesenteric .	{ Offsets to the large intestine Superior hæmorrhoidal.	
HYPOGASTRIC PLEXUS† ends in the pelvic plexus on each side, which gives the following plexuses:	Inferior hæmorrhoidal		
	vesical	{ Prostatic cavernous deferential to vesiculae seminales.	
	uterine		
	vaginal.		
GANGLIATED CORD of the sympathetic in the abdomen supplies	External branches .	{ To the lumbar and sacral spinal nerves.	
	internal	{ To aortic plexus to hypogastric plexus to join round middle sacral artery between the cords on the coccyx, in the <i>ganglion impar</i> .	

* This receives { Great splanchnic nerves
part of small splanchnic
offset of pneumo-gastric.

† This is joined { The aortic plexus
above by . . . { filaments from the lum-
bar ganglia.

PNEUMO-GASTRIC NERVE IN THE ABDOMEN.

Pneumo-gastric.	Right	{ Coronary branches to the back of the stomach filaments to join the coeliac and splenic plexuses.
	left	{ Coronary branches to the front of the stomach and the hepatic plexus.

CHAPTER IX.

DISSECTION OF THE LOWER LIMB.

SECTION I.

THE FRONT OF THE THIGH.

- Directions.** ALL the parts described in Section I. are to be examined before the time for turning the body arrives.
- Position of the body.** *Position.*—During the dissection of the front of the thigh the body should lie on the back, with a block of a suitable size beneath the loins, and the lower limbs should hang over the end of the dissecting table. The limb is to be rotated outwards, so as to make evident a hollow at the upper part of the thigh; and it is to be supported in a half bent position by means of a stool beneath the foot.
- Objects on the surface.** *Surface marking.*—Before any of the integument is removed from the limb, the student is to observe the chief markings and eminences on the surface of the thigh.
- Prominences limiting the thigh above.** The limit between the thigh and the abdomen is marked in front by the firm band of Poupart's ligament intervening between the crest of the hip bone and the pubes. On the outer side the separation is indicated by the convexity of the iliac crest of the hip bone, which subsides behind in the sacrum and coccyx. On the inner side is the projection of the pubes, from which a line of bone (pubic arch) may be traced backwards along the inner and upper part of the limb to the ischial tuberosity.
- Hollow of Scarpa's space.** On the anterior aspect of the thigh, and close to Poupart's ligament, is a slight hollow, corresponding with the triangular space of Scarpa, in which the larger vessels of the limb are contained; and extending thence obliquely along the inner side of the limb, is a slight depression marking the situation of the femoral artery beneath. The position of the arterial trunk may be ascertained by a line on the surface from the centre of the interval between the symphysis pubis and the crest of the hip bone, to the inner condyle of the
- Groove over femoral artery.**

femur. On the outer side of the thigh, about four inches below the iliac crest and the same distance from its anterior spine, the student will be able to recognise the well-marked projection of the great trochanter of the femur. In a thin body the head of the femur may be felt by rotating the limb inwards and outwards, whilst the thumb of one hand is placed in the hollow below Poupart's ligament, and the fingers behind the great trochanter.

Position of
great tro-
chanter.

Head of the
femur.

At the knee the outline of the several bones entering into the formation of the joint may be traced with ease. Thus, in front of the joint, when it is half bent, the rounded prominent patella may be perceived; this is firmly fixed whilst the limb is kept in the same position, but is moved with great freedom when the joint is extended so as to relax the muscles that are inserted into it. On each side of the patella is the projection of the condyle of the femur, but that on the inner side is the largest. If the fingers are passed along the sides of the patella whilst the joint is half bent, they will be conducted by the condyles of the femur to the tuberosities of the head of the tibia, and to a slight hollow between the bones. Behind the joint is a slight depression over the situation of the ham or popliteal space; and on its sides are firm boundaries, formed chiefly by the tendons (hamstrings) of the flexor muscles of the leg.

Bony emi-
nence of
knee.

Patella.

Condyles of
the femur.

Tuberosities
of the tibia.

The ham
behind.

Dissection.—With the position of the limb the same as before directed, the student begins the dissection with the examination of the subcutaneous fatty tissue with its nerves and vessels.

Dissection.

At first the integument is to be reflected only from the hollow on the front of the thigh close below Poupart's ligament. To raise the skin from this part an incision about four inches in length, and only skin deep, is to be made from the pubes along the inner border of the thigh. At the lower end of the first incision, another cut is to be directed outwards across the front of the limb to the outer aspect; and at its upper end the knife is to be carried along the line of Poupart's ligament as far as the crest of the hip bone. The piece of skin included by these incisions is to be raised and turned outwards, without taking with it the subcutaneous fat.

Take up the
skin at the
top of the
thigh.

The subcutaneous fatty tissue, or the *superficial fascia*, forms a general investment for the limb, and is constructed of a network of areolar tissue, with fat or adipose substance amongst the meshes. As a part of the common covering of the body, it will be found continuous with that of the

Superficial
fascia,

how
formed;

thickness
varies;

it is divided
into two
strata by
vessels.

To raise the
superficial
stratum.

Subcutane-
ous layer of
the fascia

ununit-
ed with Pou-
part's liga-
ment.

Dissection.

To see the
superficial
vessels,

lymphatics,

and nerves.

neighbouring regions, so that it may be followed inwards to the scrotum or labium, and upwards on the abdomen. Its thickness varies in different bodies, according to the quantity of fat deposited in it; and at the upper part of the thigh it is divided into two strata (superficial and deep) by some cutaneous vessels and inguinal glands. The superficial of the two layers is apparent after the removal of the skin, but its connections will be made more evident by the following dissection.

Dissection.—To reflect the superficial stratum of the fascia, incisions similar to those in the skin are to be employed, though they are not to reach so low on the thigh; and the separation from the subjacent structures is to be begun at the lower part, where the large saphenous vein, and a condensed or membranous appearance on the under surface, will mark the depth of the stratum. The handle of the scalpel may be advantageously employed in raising the fascia along the middle line of the limb; but, where vessels and glands are not found, viz. along the outer and inner borders of the thigh, the separation of the superficial fascia into two layers cannot be easily made without the knife.

The *subcutaneous layer* of this fascia decreases in thickness near Poupart's ligament, becoming more fibrous at the same spot; and at its under aspect is a smooth and membranous surface. It conceals the superficial vessels and the inguinal glands, and is separated by these from Poupart's ligament, so that it is unconnected to that band as it passes upwards to the abdomen, and is readily moved on it either upwards or downwards.

Dissection.—The inguinal glands and the superficial vessels are to be next laid bare by the removal of the surrounding fat; but the student is to be careful not to destroy the deeper, very thin layer of the superficial fascia which is beneath them, and is visible chiefly on the inner side of the centre of the limb.

Three sets of vessels are to be found in the dissection. One set (artery and vein) is directed inwards to the pubes, and is named external pudic; another, superficial epigastric, ascends over Poupart's ligament; and the third, or the superficial circumflex iliac, appears at the outer border of the limb. The large vein in the middle line of the thigh to which the branches converge, is the internal saphenous. Some of the small lymphatic vessels may be traced from one inguinal gland to another.

A small nerve, the ilio-inguinal, is to be sought on the

inner side of the saphenous vein, and close to the pubes ; and one of the branches of the genito-crural nerve may be found a little outside the vein.

SUPERFICIAL VESSELS.—The small cutaneous arteries at the top of the thigh are the highest branches of the femoral artery, and are furnished by that trunk as soon as it enters the thigh. They pierce the deep fascia of the limb (*fascia lata*), and are distributed in the integuments and the glands of the groin. The arteries from the femoral.

A vein accompanies each artery, having the same name as its companion vessel, and ends in the upper part of the saphenous vein ; but the description of these veins will be given in a subsequent page (673). Veins join the saphenous.

The *external pudic* artery (superior) crosses the spermatic cord in its course inwards, and ends in the integuments of the penis and scrotum, where it anastomoses with offsets of the internal pudic artery. Another external pudic branch (inferior) pierces the *fascia lata* at the inner border of the thigh, and ramifies also in the scrotum. In the female these branches supply the labium pudendi. One external pudic artery ; another beneath the fascia.

The *superficial epigastric* artery passes over Poupart's ligament to the lower part of the abdomen (p. 480), and communicates with branches of the deep epigastric artery. Superficial epigastric.

The *superficial circumflex iliac* artery is the smallest of the three branches ; and appearing on the outer border of the thigh near the iliac crest, is distributed in the integuments. Superficial iliac.

The *superficial inguinal glands* are arranged in two lines. One set lies across the thigh, near Poupart's ligament ; and the other is situate along the side of the saphenous vein. In the lower or longitudinal collection the glands are larger than in the upper, and the lymphatic vessels from the surface of the lower limb enter them ; whilst the upper or transverse set are joined by the lymphatics of the penis, and by those of the lower part of the abdomen and the buttocks. The glands vary much in number and size, and not unfrequently those by the side of the vein are united together. Inguinal glands ; two sets, which receive different lymphatics.

Dissection.—The deeper layer of the superficial fascia is to be detached from the subjacent *fascia lata*, by means of incisions similar to those for reflecting the subcutaneous stratum, except that the lower cut across the thigh is not to be made so far down. The handle of the scalpel is to be employed in the separation, and the dissector is to endeavour to avoid cutting the nerves and vessels. Internal to the saphenous vein a thin membrane can be easily raised, but Raise the deep stratum of the superficial fascia.

external to that vessel there exists scarcely a continuous layer distinct from the fascia lata. In reflecting the stratum the margin of an aperture (saphenous) in the fascia lata will become apparent.

Deep part of the superficial fascia The deeper layer of the superficial fascia is a very thin membraniform stratum, which is most evident near Poupart's ligament and on the inner side of the saphenous vein. About one inch below the ligament it conceals the large saphenous opening in the fascia lata, and is there pierced by the saphenous vein with some ducts of the lymphatic glands. As it stretches across the opening it is connected to the circumference,—internally by loose areolar tissue, but externally by firm fibrous bands; and it is also connected with the loose crural sheath of the subjacent vessels in the aperture. The part of this stratum over the saphenous opening is perforated by many small apertures for the transmission of the lymphatics; and it has been named *cribriform* fascia from its sieve-like appearance. In a hernial protrusion through that opening the cribriform portion is projected forwards by the gut, and forms one of the coverings.

covers saphenous opening.

where it is named cribriform fascia.

Dissection of the front of the thigh. *Dissection.*—When the student has observed the disposition of the superficial fascia near Poupart's ligament, he may proceed to examine the remainder of this subcutaneous covering of the thigh, together with the vessels and the nerves in it.

Take away the skin, To raise the skin from the front of the thigh, a cut is to be carried along the centre of the limb, over the knee joint, to rather below the tubercle of the tibia. At the extremity a transverse incision is to be made across the front of the leg, but this is to reach farthest on the inner side. The flaps of the skin may be reflected inwards and outwards.

and follow saphenous vein, The saphenous vein is first to be traced out as far as the skin is reflected, but in removing the tissue from it the student should be careful of branches of the internal cutaneous nerve.

Seek cutaneous nerves of front of thigh, The cutaneous nerves of the front of the thigh are to be sought in the fat in the following positions:—On the outer margin is the external cutaneous nerve. In the centre are the branches of the middle cutaneous nerve. Whilst at the inner margin lie the ramifications of the internal cutaneous nerve,—one small offset appearing near the upper part of the thigh; one or more about the middle; and one of the terminal branches (anterior) about the lower third.

and on side of the knee, On the inner side of the knee three other cutaneous

nerves are to be looked for ;—One is a branch of the great saphenous, which is directed to the front of the patella. Another is the trunk of the great saphenous nerve, which lies by the side of the vein of the same name, close to the lower part of the surface now dissected. And the third is a terminal branch (inner) of the internal cutaneous nerve, which is close behind the preceding, and communicates with it. Small cutaneous arteries accompany the nerves.

SUPERFICIAL VEINS.—All the veins on the anterior and inner aspects of the thigh are collected into one ; and this trunk is named saphenous from the readiness with which it may be detected on the surface.

The *internal saphenous vein* is the cutaneous vessel of the inner side and front of the lower limb ; and it extends from the foot to the upper part of the thigh, where it joins the femoral vein. In the part of its course now dissected, the vessel lies somewhat behind the knee joint inferiorly ; but as it ascends to its termination, it is directed along the inner side and the front of the thigh. Near Poupart's ligament it pierces the fascia lata by a special opening named saphenous, and enters, as before said, the deep vein of the limb.

Superficial branches join it both externally and internally ; and near Poupart's ligament the three veins corresponding with the arteries in that situation, viz. superficial pudic, epigastric, and circumflex iliac, terminate in it. Towards the upper part of the limb the veins of the inner side and back of the thigh are most frequently united into one branch, which enters the trunk near the aperture in the fascia lata ; and sometimes those on the outer side of the thigh are collected together in a similar way, so as to produce three large veins on the front of the thigh near the saphenous opening. On the side of the knee the vein receives generally a deep branch from the joint.

Some unnamed *cutaneous arteries* are distributed to the integuments along with the nerves ; and the superficial branch of the anastomotic artery (p. 689) accompanies the saphenous nerve near the knee.

CUTANEOUS NERVES.—The cutaneous nerves of the thigh are derived from branches of the lumbar plexus (p. 597), and are distributed in greater abundance on the inner than the outer margin of the limb.

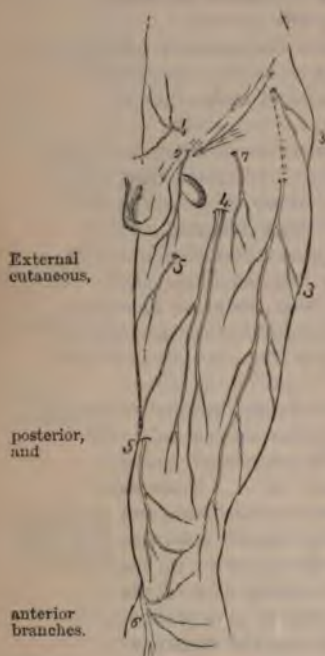
Ilio-inguinal.—This nerve (p. 598) is small in size, and reaches the surface by passing through the external abdominal ring (fig. 102, ²) ; it supplies the scrotum, and ends

in the contiguous part of the thigh internal to the saphenous vein.

Genito-crural reaches the middle.

Genito-crural.—The *crural* branch of this nerve (p. 599) pierces the fascia lata near Poupart's ligament (fig. 102,⁷), rather external to the line of the femoral artery. After the nerve has become superficial it communicates

Fig. 102.*



with the middle cutaneous nerve, and extends on the anterior aspect of the thigh as far as midway between the knee and the pelvis. Occasionally this branch is of large size, and takes the place of branches of the external cutaneous nerve on the outer side of the limb.

The *external cutaneous* nerve (p. 599) is distributed on the outer aspect of the limb (fig. 102,³). At first it is contained in a prominent ridge of the fascia lata on the outer margin of the thigh, where it divides into an anterior and a posterior branch.

a. The *posterior* branch is soon subdivided into two or three others, which arch backwards, supplying the integuments of the outer part of the thigh as low as the middle; and the highest offsets are crossed by branches of the last dorsal nerve.

b. The *anterior* branch extends to the lower half of the thigh. It appears on the surface of the fascia lata, about four inches from Poupart's ligament; and, continued to the knee, it distributes branches laterally, but those towards the outer and posterior surfaces are the most numerous, and the largest in size. Near the knee it communicates sometimes with the branch of the great saphenous nerve.

Middle cutaneous

Middle cutaneous (fig. 102⁴).—The nerve for the centre of the thigh in front is a cutaneous offset from the anterior

* Cutaneous nerves on the fore part of the thigh.—1. Ilio-hypogastric branch on the belly. 2. Ilio-inguinal nerve. 3. 3. External cutaneous—the two parts. 4. Middle cutaneous. 5. 5. Internal cutaneous: the lower figure marks the anterior branch of the nerve. 6. Saphenous nerve. 7. Crural branch of the genito-crural nerve.

crural, and divides into two branches that may pierce the fascia at separate spots. It is transmitted through the fascia lata about three inches from Poupart's ligament, and its branches are continued to the knee, where it communicates with the offset of the great saphenous nerve over the patella. In the fat this nerve is united with the genito-crural and internal cutaneous nerves. In some instances the nerve is inclined to the inner side of the knee, and is substituted for a branch (anterior) of the following nerve.

Internal cutaneous.—Derived from the anterior crural trunk, like the preceding, this nerve is furnished to all the inner side of the thigh. It is divided into two branches (anterior and inner), which perforate the fascia in separate places.

a. The *anterior* branch becomes cutaneous in the lower third of the thigh in the line of the inner intermuscular septum (fig. 102, ⁶), along or somewhat behind which it is continued to the knee. This branch is distributed in the lower third of the thigh at the inner part, as well as over the patella and the inner side of the knee joint, and is united with the branch of the internal saphenous nerve. Occasionally this part of the nerve is found below the level of the knee joint; and in that case it is larger than usual, and is joined by a small offset from the saphenous nerve.

b. The *inner* branch (fig. 105, ¹) perforates the fascia at the inner side of the knee behind the internal saphenous nerve, with which it communicates; it furnishes offsets to the lower part of the thigh, and the upper half of the leg on the inner surface.

c. Other small offsets for the supply of the inner side of the thigh arise from the trunk, or from the two branches of the internal cutaneous nerve, and appear by the side of the saphenous vein. One or two come into view near the upper part of the vein, and reach as far as the middle of the thigh; and one, larger in size than the rest, appears where the others cease, and extends as far as the knee. These cutaneous offsets usually communicate.

Internal saphenous (fig. 102, ⁶).—A branch of the anterior crural, like the two preceding, this nerve is continued to the foot, but only a little part of it is now visible. The nerve pierces the fascia on the inner side of the knee, and, after communicating with the inner branch of the internal cutaneous, gives forwards some offsets over the knee joint; finally it accompanies the saphenous vein to the leg and foot.

a. A *patellar* branch of the saphenous nerve appears on

x x 2

from it over the patella the surface of the fascia, higher than the trunk from which it springs. It is soon joined by the internal cutaneous nerve, and ends in many branches over the patella; its ramifications communicate with offsets from the trunk of the saphenous nerve and the external and middle cutaneous, and form an interlacement—*plexus patellæ*—over the joint. When this branch is small its place is taken by the internal cutaneous nerve.

forms a plexus with others.

Clean the surface of the fascia lata,

and define saphenous opening.

Dissection.—Let the fat and the inguinal glands be now removed from the surface of the fascia lata, the cutaneous nerves being thrown aside to be traced afterwards to their trunks.

At the upper part of the thigh the student is to define the inner margin of the saphenous opening by detaching the superficial fascia. The outer border is blended with the subjacent crural sheath as well as with the superficial fascia; and it is only after the uniting fibrous bands are broken or cut through, that the outer semilunar margin of the saphenous opening comes into view. The student must not expect to find it so defined as it is represented in drawings.

Fascia lata surrounds limb;

strength varies.

Apertures in it.

Processes between the muscles.

Connected with bone at upper part of thigh.

The *fascia lata* is the deep aponeurosis of the thigh. It surrounds the limb with a firm sheath and sends inwards septa between the different muscles. This membranous investment is of a bluish white colour. It is stronger on the outer than on the inner aspect of the limb, in consequence of the insertion into it of the tensor vaginae femoris and gluteus maximus muscles. In fat bodies it is sometimes so slight as to be taken away with the subcutaneous fat.

Numerous apertures exist in the fascia for the transmission of the cutaneous nerves and vessels; and the largest of these is near Poupart's ligament, for the passage of the internal saphenous vein. Processes prolonged from the under surface form septa between, and fibrous sheaths around the several muscles. Some of the processes are larger than the rest, and are named specially the intermuscular septa of the thigh:—Thus two, outer and inner, are fixed to the femur, so as to limit on the sides the extensors of the knee; and a third piece intervenes between the adductors of the thigh and the flexors of the knee. The position of these partitions is marked on the surface by white lines.

At the upper part of the thigh the fascia is fixed to the prominent borders of the pelvis. Externally it is connected with the iliac crest; and internally with the pubes and the pubic arch. In the middle line behind it is joined to the lower end of the sacrum and the coccyx; and in front to

Poupart's ligament between the pubes and the iliac crest. At the lower part of the thigh, behind the knee joint, it passes uninterruptedly to the leg; but in front of the articulation it is blended with an expansion from the extensor muscles, and is continued over the patella, though separated from the bone by a bursa, to be inserted into the heads of the tibia and fibula.

Difference
at lower
part.

Directions.—The flaps of skin that were removed from the front of the thigh, to follow the cutaneous vessels and nerves, are to be now replaced, and the saphenous opening is to be learnt.

Replace
flaps of skin.

The *saphenous opening* in the fascia lata (fig. 73) receives its appellation from transmitting the saphenous vein. This aperture is oval in form, and is situate rather to the inner side of the middle line of the thigh. It measures about half an inch in width and one inch and a half in length. Its upper extremity (superior cornu) is at Poupart's ligament; and its lower extremity (inferior cornu) is distant from that structure about one inch and a half, and presents a well defined margin.

Saphenous
opening:
situation,
form, and
size.

The inner part of the opening is posterior to the level of the femoral vessels. It is deficient above in a prominent edge, for the fascia constructing it is stretched over a flat subjacent muscle (pectineus); but it is marked below by a firm and sharp border.

Inner mar-
gin sharp
below;

The outer boundary is much stronger, and has a semi-lunar border when detached, whose concavity is turned downwards and inwards. This edge is named from its shape *falciform* border or margin of the saphenous opening (falciform process of Burns): it is superficial to the femoral vessels, and is connected by fibrous bands to the crural sheath, and to the deep layer of the superficial fascia. If the outer edge be traced upwards (fig. 75, ⁶) it will be found to reach to the inner side of the femoral vein, and to blend with the base of Gimbernat's ligament (part of the insertion of Poupart's ligament): the upper end of this border, where it is internal to the vessels, has been known as the *femoral* ligament.

outer is firm
and semi-
lunar when
separate,

and arches
to join Gim-
bernat's
ligament.

The rigidity of the margin of the saphenous opening is much influenced by the position of the limb; for if the finger be placed beneath the upper part of the falciform border whilst the limb is moved in different directions, the dissector will perceive that this band is most unyielding when the limb is extended and rotated outwards, and most relaxed when the thigh is flexed and turned in the opposite direction.

Tenseness of
the margins
depends on
the position
of the limb.

Parts transmitted through the opening.

Names for fascia.

Anatomy of parts concerned in femoral hernia.

Dissection to see a sheath around femoral vessels.

Define sheath.

The crural arch; attachments; form.

Parts close

Through the lower part of the opening the saphenous vein and the ducts of the inguinal glands are transmitted : and through the upper part, close to the falciform edge, a femoral hernia would project.

Other terms are applied to the fascia on the opposite sides of the saphenous opening ; thus the piece on the outer side is called iliac part from its attachment to the iliac crest ; whilst that on the inner side, which is fixed to the pubes (fig. 73, *), is named in like manner the pubic part of the fascia lata.

PARTS CONCERNED IN FEMORAL HERNIA.—Besides the saphenous opening the dissector has to study the undermentioned parts, to obtain a knowledge of the structures amongst which the hernial protrusion is situate ; viz. the crural arch and Gimbernat's ligament, the crural sheath, the crural canal and the crural ring, together with a partition (septum crurale) between the thigh and the abdomen.

Dissection.—To examine Poupart's ligament and a loose sheath of membrane around the femoral vessels, the piece of the fascia lata outside the saphenous opening is to be reflected inwards by the following incisions. One cut may be begun near the edge of the falciform border, and may be carried outwards for one inch and a half, parallel and close to Poupart's ligament. Another is to be directed obliquely downwards and inwards from the termination of the first, to a little below the inferior cornu of the opening. When the fascia has been turned inwards and some fat removed, the tube of membrane (crural sheath) will be brought into view as it descends beneath Poupart's ligament.

With the handle of the scalpel the sheath is to be separated carefully from the fascia lata beneath, and from the ligament in front of it ; and Gimbernat's ligament on the inner side of the sheath, to which the upper end of the falciform border is united, is to be defined.

Poupart's ligament, or the crural arch, is a firm band of the aponeurosis of the external oblique muscle of the abdomen, which stretches from the front of the iliac crest to the pubes (p. 487). When viewed on the surface, the arch has not a straight direction between its bony attachments as long as the fascia lata is uncut, but is curved downwards towards the thigh. The outer half is oblique. But the inner half is almost horizontal, and widens as it approaches the pubes, where it is inserted into the spine, as well as into the pectineal line of the hip bone for about an inch as Gimbernat's ligament.

The space between the crural arch and the innominate

bone is closed by the parts passing from the abdomen to the thigh, and is larger in the female than in the male. The outer half of the interval is filled by the fleshy psoas and iliacus muscles, to which the arch is closely bound by fascia; and the inner half of the space is occupied by the femoral vessels and their sheath.

ing hollow
beneath.

Gimbernat's ligament.—The structure named Gimbernat's ligament, is the part of the tendon of the external oblique muscle of the abdomen that is inserted into the pectineal line of the hip bone (p. 487). Viewing it as a separate structure, it is about one inch in length and triangular in shape. Its apex is at the pubic spine; whilst its base is in contact with the crural sheath, and is blended with the fascia lata,—the part that forms the outer side of the saphenous opening. By one margin (anterior) it is continuous with the crural arch, and by the opposite it is fixed to the pectineal line. In the erect position of the body the ligament is almost horizontal, and one surface is directed upwards to the abdominal cavity, whilst the other is turned towards the thigh. On forcibly raising the crural arch, the continuity of Gimbernat's ligament with that band will plainly appear.

Gimbernat's
ligament.

Form, situa-
tion, and
connections.

The *crural sheath* (fig. 75, ⁷) is a loose tube of membrane around the femoral vessels. It has the form of a funnel sloped unequally on the sides. The wide part or base of the tube is upwards; and the narrow part ceases about two inches below Poupart's ligament by blending with the common areolar sheath of the bloodvessels. Its outer border is nearly straight, and is perforated by the genito-crural nerve. Its inner border is oblique, and is pierced by the lymphatics and the saphenous vein; this part of the sheath appears in the saphenous opening, and is connected to the falciform margin and the superficial fascia. In front of the crural sheath and behind it is the fascia lata of the thigh. The sheath is continuous with the fasciæ lining the abdomen in this way;—the anterior part is prolonged beneath Poupart's ligament into the fascia transversalis, and the posterior half is continued into the fascia iliaca (p. 510).

Part of
Poupart's.

Crural
sheath.

Shape
and connec-
tions.

How
formed.

Crossing the front of the crural sheath below the arch of Poupart's ligament, is a thickened fibrous band, which has been named the *deep crural arch*. A notice of it is given with the description of the fascia transversalis (p. 497). This band is supposed to occasion sometimes the stricture of the subjacent intestine in a femoral hernia.

Deep crural
arch.

Dissection.—The student is to open the sheath by an incision across the front, and to raise the loose anterior part

Open the
crural
sheath.

with hooks. A piece of the areolar casing of the femoral vessels within the crural sheath is to be cut out over both the artery and the vein. When this has been done two thin partitions may be defined; one is on the inner side of the vein separating it from a gland, and the other is between the vein and the artery. A fatty stratum may be seen over the upper aperture of the sheath, closing the tube towards the abdomen.

Contents of the sheath. *Interior of the crural sheath.*—The sheath contains the femoral vessels, and is divided into three compartments by two partitions. The position of the septa has been before referred to,—one being internal to the femoral vein, and the other between the two large vessels. In the outer com-

*Space di-
vided into
three parts.*

partment is the femoral artery, lying close to the side of the sheath (fig. 75, ^a); in the middle one is the femoral vein (fig. 75, ^b); and in the inner space (crural canal) is only a lymphatic gland. The femoral vessels are surrounded by a common covering of areolar tissue, which is distinct from the crural sheath now described.

*The inner
of the three
spaces is
the crural
canal.*

Crural canal (fig. 75).—The innermost space in the interior of the crural sheath has this designation:—Its length is from a quarter to half an inch, for it reaches only from the base of Gimbernat's ligament to the upper cornu of the saphenous opening. Anterior to the sheath at this part, and consequently to the contained space, are Poupart's ligament and the upper end of the falciform margin of the saphenous opening; whilst behind it is the pectineus muscle, covered by fascia lata. In the sheath, but on the outer side of the canal, is the femoral vein. The aperture above by which the space communicates with the cavity of the abdomen is named the crural ring. Through this channel the intestine in femoral hernia passes from the abdomen.

*Extent and
parts around
it.*

*Crural ring.
Situation
and form.*

The *crural ring* is the upper opening of the crural canal into the abdominal cavity.* It is on a level with the base of Gimbernat's ligament, and is larger in the female than in the male. It is oval in shape; and its greatest measurement is from side to side, in which direction it equals about half an inch. The structures around the opening, and outside the crural sheath, are nearly similar to those bounding the crural canal, viz., in front the crural arch with the spermatic

*Structures
around.*

* Gimbernat used the name crural ring, and Mr. Lawrence proposes to call it femoral aperture. Might not the nomenclature be made to resemble more that used in describing inguinal hernia, by calling this opening the internal crural aperture, and the saphenous opening the external crural aperture?

cord in the male, and the round ligament in the female; and behind, the pubes covered by fascia lata. Internally is Gimbernat's ligament; and externally, but within the sheath, is the femoral vein. The position of the vessels on the several sides of the ring is stated at p. 510.

Septum crurale.—That part of the subperitoneal layer of fat, which is placed over the opening of the crural ring, has been named crural septum from its position between the thigh and the abdomen (Cloquet). The situation of the septum is now visible, but its characters are ascertained in the dissection of the abdomen (p. 509).

FEMORAL HERNIA.—This kind of hernia consists in a protrusion of the intestine into the thigh beneath Poupart's ligament. And the gut descends always in the crural sheath, being commonly on the inner side of the vein, though it may be placed occasionally on the outer side of the artery.

Course.—At first the intestine takes a vertical direction in its progress from the abdomen to the surface of the body, and passes through the crural ring, and along the crural canal as far as the saphenous opening. At this spot it changes its course, and is directed forwards to the surface; and should the gut protrude still farther the hernia again alters its direction, and ascends on the abdomen in consequence of the resistance being less in this direction than on the front of the thigh.

The winding course of the hernia must suggest to the dissector the direction in which attempts should be made to replace the intestine in the abdominal cavity. With the view of making the bowel retrace its course, it will be necessary if the protrusion is small to direct it backwards and upwards; but if the hernia is large it must be pressed down first to the saphenous opening, and afterwards backwards and upwards towards the crural canal and ring. The foregoing dissection will have demonstrated the necessity of raising the limb, and rotating it inwards during the manipulation to return the displaced intestine to its cavity, in order that the margin of the saphenous opening and the other tissues may be relaxed.

Coverings.—As the intestine takes the above specified course it is clothed by the following structures, which are elongated and pushed before it from within outwards. First is a covering of the peritoneum lining the abdomen. Next one from the septum across the crural ring. Afterwards comes a stratum from the crural sheath, unless the hernia bursts through an aperture in the side. Over this is spread

Crural septum;

position;

how formed.

Femoral hernia.

Definition.

Course;

first vertical,

next directed forwards, and then upwards.

By what means it is to be pushed back.

Coverings for the gut from the

peritoneum, crural septum, crural sheath,

by the skin and the superficial fascia, and by the fascia lata

Fig. 103.*



and some inguinal glands; but thence to the middle third of

* Femoral artery and its branches with muscles of the thigh (From Quain's Arteries).—1. Femoral artery. 2. Profunda artery. 3. In-

the thigh it is placed deeply beneath the sartorius muscle. At first the artery rests on the psoas muscle; and it is subsequently placed over the pectineus, though at some distance from it in this position of the limb, and separated from it by fat, and by the profunda vessels and the femoral vein.

Parts behind it.

Its companion vein and the anterior crural nerve have the following position with respect to it:—The femoral vein is on the inner side and close to it at the pubes, but is placed behind the artery lower down. The anterior crural nerve is on the outer side, being distant nearly half an inch near Poupart's ligament; and some of the branches of the nerve approach the artery, or lie on it, near the apex of the containing space.

Position of vein and nerve.

The branches of the first part of the artery are the superficial epigastric and circumflex iliac, two external pudic, and the deep femoral branch. The cutaneous offsets have been seen (p. 671), with the exception of the following, which is beneath the fascia lata.

Branches of this part already seen, except

The inferior *external pudic* artery arises separately from, or in common with the other pudic branch (superior) (p. 671). This branch courses inwards over the pectineus muscle to the scrotum or the labium pudendi, according to the sex; and it perforates the fascia lata at the inner border of the thigh to reach its place of destination. In the integuments it anastomoses with branches of the superficial perineal artery.

one external pudic, beneath the fascia.

The *deep femoral* branch, or the *profunda*, is the largest offset of the femoral artery, and arises from the outer part of that trunk one inch to two inches (Quain) below Poupart's ligament. It is consumed in the muscles of the thigh, and its distribution will be afterwards ascertained. In the present dissection it may be seen to lie over the iliacus muscle, where it gives the external circumflex artery to the outer part of the thigh; and then to be directed, with a large vein, beneath the trunks of the femoral vessels to the inner side of the limb.*

Profunda.

Origin

and position in Scarpa's triangle.

FEMORAL VEIN.—The principal vein of the limb, whilst in the triangular space in the upper part of the thigh, has almost the same relative anatomy as the artery. Its position

Femoral vein: first inside the artery,

ternal circumflex. 4. External circumflex. 5. Superficial circumflex—iliac and epigastric branches. 6. External pudic artery. 7. Aponeurosis over the lower part of the femoral artery. 8. Anterior crural nerve. 9. Pectineus muscle. 10. Adductor longus. 11. Gracilis. 12. Vastus internus. 13. Rectus femoris. 14. Sartorius cut across.

* Some anatomists apply the term common femoral to the part of the trunk above the origin of the profunda, and give the names superficial and deep femoral to the nearly equal parts into which it divides.

afterwards outside it. to the artery, however, is not the same throughout. Beneath Poupart's ligament it is on the inner side of that trunk, and on the same level, and is supported on the pubes between the psoas and pectineus muscles; but it soon winds beneath the artery, and appears on the outer side opposite the upper border of the adductor longus muscle. In this space the vein receives the internal saphenous and deep femoral branches.

Peculiarities in place of artery.

Peculiarities in the artery.—*Change in position.*—Four examples of transference of the main trunk of the limb from the front to the back of the thigh have been recorded. In those cases the artery passed from the pelvis through the great sacro-sciatic notch, and accompanied the great sciatic nerve to the popliteal space.

Origin of profunda varies.

Origin of the profunda.—The profunda branch, though arising commonly from the femoral artery between one inch and two inches from Poupart's ligament, may approach nearer to the ligament until it arrives opposite that band, or may even go beyond, and be fixed to the external iliac artery (one example, Quain). And the branch may recede farther and farther from the ligament, till it leaves the parent trunk at the distance of four inches from the commencement; so that in applying a ligature to the femoral artery in the upper part of the thigh, the thread should be placed four inches below Poupart's ligament, in order that the spot chosen may be free from the disturbing influence of an occasional large offset.

Position of the vein varies; or the vein may be divided.

Position of the vein.—The position of the vein with respect to the artery may be altered; for the venous trunk may be placed on the inner side through all the triangular space. Further the vein may be slit so as to present a large vein on each side of the artery for a greater or less extent, or one of the two veins may lie over the arterial tube.

Take the fascia from the front of the thigh.

Dissection.—To proceed with the deep dissection, the limb is to be retained in the same position as before, and the flaps of skin on the front of the thigh are to be thrown aside. The fascia lata is to be cut along the middle line of the thigh and knee, and to be reflected to each side nearly to the same extent as the skin. Over the knee joint the student will find the fascia united with the tendon of the extensor muscles of the leg, so as to form lateral accessory ligamentous bands.

Follow out sartorius

In raising the inner piece of the fascia the narrow muscle then appearing (sartorius) should be followed to its insertion into the tibia: and care should be taken of the small nerves along its inner border, viz.:—the two branches of the internal cutaneous above; the great saphenous and its branch below; and a plexus between the saphenous, internal cutaneous, and obturator, at the middle of the thigh. The dissector is to avoid displacing the muscle whilst he is removing its sheath of fascia; and to retain it in the natural position he may fix it with stitches.

and preserve nerves in contact with it.

Internal to the sartorius are some strong muscles (adductors) that are inclined outwards from the pelvis to the femur. The student is to lay bare these muscles; and beneath the more superficial muscle (adductor longus), near where this touches the sartorius, he is to seek a branch of the obturator nerve to the plexus before mentioned.

Dissect the adductors,

On the outer side of the sartorius is the large extensor of the leg. For the dissection of its fleshy parts the knee is to be bent to make tense the fibres; and an expansion below from the common tendon to the fascia lata and the knee joint is to be looked to.

and clean the extensor muscles.

One little muscle at the upper and outer part of the thigh, —tensor of the fascia lata, is to be cleaned; and a strip of the fascia, corresponding with its width, should be left along the outer aspect of the thigh. Behind this slip the investing membrane is to be divided by one or two transverse cuts, and is to be followed backwards to its attachment to the lines on the femur.

Dissect tensor of fascia.

DEEP PARTS ON THE FRONT OF THE THIGH.—The muscles on the front of the thigh are the sartorius, and the extensor of the leg. Several muscles are combined in the extensor, viz. the rectus, vastus externus, and vastus internus and crureus. At the top of the thigh is the small tensor of the fascia lata.

Muscles on the front of the thigh.

A portion of the femoral artery, viz. the lower half, lies amongst the muscles and supplies them with branches.

Vessels.

One large nerve, the anterior crural, furnishes offsets to the muscles on the front of the thigh, and is to be learnt with them.

Nerves.

The SARTORIUS is the longest muscle in the body, and extends from the pelvis to the leg. It arches over the front of the thigh, passing from the outer to the inner side of the limb, and lies in a hollow between the extensors on the one side, and the adductors on the other. Its origin is tendinous from the upper anterior iliac spinous process of the hip bone, and from about half the interval between this and the inferior process. The fibres constitute a thin, riband-like muscle, which ends in a thin tendon below the knee, and is inserted into the inner surface of the tibia,—mainly into a slight depression by the side of the tubercle for an inch and a half, but also by its upper edge as far back as to the internal lateral ligament of the knee joint.

Sartorius

origia:

course over the thigh: insertion.

The muscle is superficial throughout, and is perforated by some cutaneous nerves and vessels. Its upper part is

may be inside the artery ; or split ; or very small.

here, as in the upper part (p. 686), and may be found on the inner side of the artery ; or it may be divided into two trunks, which lie on the sides of its companion vessel.

Size of the vein.—In some bodies this part of the femoral vein is very small in size, in consequence of the popliteal coursing along the back of the thigh to enter the profunda vein, instead of accompanying the main artery of the limb through the aperture in the adductor magnus.

To expose muscles on front of the femur.

Dissection.—The femoral artery and vein are to be cut across below the origin of the profunda, and are to be thrown downwards, preparatory to the deeper dissection. Afterwards all the fat and the small veins are to be carefully removed from amongst the branches of the profunda artery and anterior crural nerve. By this step the upper part of the vastus internus and crureus will be prepared for learning.

Tensor vaginae femoris arises from pelvis,

The TENSOR VAGINÆ FEMORIS occupies the upper third of the thigh, and is the smallest and the most external of the outer set of muscles. It takes *origin* from the front of the crest of the hip bone at the outer aspect, from the anterior upper iliac spine, and from the part of the notch between this and the inferior spine, viz. as far as the attachment of the sartorius. Its fibres form a fleshy belly about two inches wide, and are *inserted* into the fascia lata about three inches below the great trochanter of the femur and rather anterior to it.

Parts around.

At its origin the muscle is situate between the sartorius and the gluteus medius. Beneath it are the ascending branches of the external circumflex artery, and a branch of the superior gluteal nerve that enters its under surface. A strong sheath of fascia surrounds the muscle.

Cut through the last muscle.

Dissection.—After the muscle has been learnt, the slip of fascia extending from it to the knee may be cut through ; and when it is detached from the muscles around the head of the rectus muscle may be followed to the pelvis.

Outline of muscles on front of thigh.

The TRICEPS EXTENSOR of the leg consists of three parts, which may be described as three muscles with a common insertion, viz. rectus, vastus externus, and vastus internus and crureus. Or, like the extensor of the arm, the muscle may be considered single below and attached by a common tendon ; but divided above into three heads, which are inserted into separate points of bone.

Rectus has an

origin at the pelvis,

The RECTUS FEMORIS forms a fleshy prominence on the front of the thigh (fig. 103, ¹³), and reaches from the pelvis to the common insertion. At its *origin* from the pelvis the muscle has two tendinous processes or heads :—one arises

from the anterior inferior iliac spinous process ; the other (to be afterwards seen) is fixed into a depression on the back of the hip bone, close above the brim of the acetabulum. Fleshy fibres succeed to tendon ; and they end inferiorly in another tendon which joins the tendinous parts of the muscles beneath, and is inserted with them into the head of the tibia.

which is double,

and an insertion into the head of the tibia.

The rectus is larger at the middle than at the ends ; and its fibres are directed from the centre to the sides, as in a quill, and give rise to that condition called penniform. It is subcutaneous, except above where it is overlaid by the sartorius. It conceals branches of the external circumflex artery and anterior crural nerve, and rests on the muscular mass of the vastus and crureus. The upper tendon of the muscle reaches farthest on the anterior surface where the sartorius touches, whilst the lower tendon is most extensive on the posterior aspect, or towards the subjacent muscles.

The muscle is penniform, and superficial, except above.

Dissection.—To see the remaining muscles, cut across the rectus near the lower end, and raise it without injuring the branches of vessels and nerves beneath. The muscular mass on the front of the femur is to be divided into two along the situation of some descending vessels and nerves. The part external to the vessels is the vastus externus, and the larger mass, internal to them, is composed of the conjoined vastus internus and crureus. If the student wishes to make two of the last-mentioned muscle, he may carry the scalpel through the fibres in a line with the inner border of the patella.

Cut the rectus,

and separate the parts of the extensor.

The VASTUS EXTERNUS is one of the parts of the strong extensor muscle of the leg, and its attachment to the femur is very narrow in comparison with its size and thickness. It has a lengthened *origin* externally, which is from a quarter to half an inch thick for the most part. Thus, beginning above, it arises from the root of the neck of the femur, and from the fore part and outer surface of the root of the great trochanter ; from the line connecting the trochanter with the linea aspera, as well as from the outer margin of the linea aspera, and from two-thirds of the line to the outer condyle ; and, lastly, from the external intermuscular septum. Inferiorly the fibres of the muscle end in an aponeurosis ; and this blends with the tendons of the rectus and vastus internus to form a common tendon.

Vastus externus.

is thin at the origin ;

The muscle is pointed at the upper part, but enlarged below where it produces the prominence on the outer side of the thigh. Its cutaneous surface is aponeurotic above, and

but is thicker below, at its insertion.

Parts in contact with the surfaces.

Vastus internus and crureus.

One mass on the front of the femur.

Its origin ;

insertion by a common tendon.

Upper part deep, lower superficial.

Lay bare the common tendon of the extensor.

Tendon of the extensor ;

attach-ments.

Bursa beneath.

Expansion from it.

is covered by the rectus, tensor vaginæ femoris, and gluteus muscles. The deep surface touches the vastus internus and crureus, and receives branches of the external circumflex artery and anterior crural nerve.

The VASTUS INTERNUS and CRUREUS are inseparably united in one muscle (fig. 103, ¹²). The fleshy mass arises from the anterior and lateral surfaces of the femur, except at the ends, and its limits may be thus indicated :—Upwards it reaches as far as the anterior intertrochanteric line ; and downwards, to about two inches from the articular end of the femur. Outwards it extends to the vastus externus ; and inwards, to the internal margin of the linea aspera, as well as to the lines continued upwards and downwards from it, some of the lowest fibres taking origin also from the tendon of the adductor magnus. At the lower end of the muscle the fibres terminate in a cutaneous aponeurosis that blends in the common tendon of insertion.

The upper part of the muscular mass is buried beneath the sartorius and rectus muscles ; but the lower part is superficial, and projects more than the vastus externus at the opposite side of the thigh. The adductor muscles are almost inseparably joined with the vastus along the attachment to the linea aspera.

Dissection.—The common tendon of the vasti and rectus can be demonstrated, after the expansion from it over the knee joint is divided along the middle of the patella to the head of the tibia. By reflecting inwards and outwards that thin fibrous layer the tendon will be evident. A strong transverse band will be seen likewise on each side of the patella, of which the outer is the strongest.

The tendon of the extensor muscles of the leg is common to the rectus, the vastus externus, and the united vastus internus and crureus. It is placed in front of the knee joint, to which it serves the office of an anterior ligament. Wide above where the muscular fibres terminate, it narrows as it descends over the joint, and is inserted inferiorly into the prominence of the tubercle of the tibia and into the bone below it for an inch. Close to its attachment to the tibia a synovial bursa is beneath it ; and in its fibres the patella is situate, like a sesamoid bone in other situations. (See Ligament of the Patella.) From the upper part of the tendon an aponeurotic expansion is derived ; this prolongation, which is strongest on the inner side, is united with the fascia lata and the other tendinous offsets to form a capsule around the joint, and is fixed below to the heads of the tibia and fibula.

Subcrureus muscle.—Beneath the united vastus and crureus, near the knee joint, is a thin band of pale fibres. It is but a part of the large muscle on the front of the femur, which is separated from the rest of the fibres by a layer of areolar tissue. Attached therefore to the femur in the lower fourth, it ends in aponeurotic fibres on the outer surface of the synovial sac of the knee joint.

Small subcrureus muscle;

ends on the synovial sac.

Intermuscular septa.—The processes of the fascia lata that limit laterally the extensor muscles of the knee, are thus named, and are fixed to the linea aspera, and the lines leading from it to the condyles of the femur.

Intermuscular septa are two.

The *external septum* is the strongest, and reaches from the outer condyle of the femur to the insertion of the gluteus maximus. It is situate between the vastus externus and the short head of the biceps, to which it gives origin; and it is perforated near the outer condyle by the upper external articular vessels.

The outer is the strongest;

The *inner partition* is very thin along the side of the vastus internus; and its place is supplied by the strong tendon of the adductor magnus between the inner condyle and the linea aspera. The internal articular vessels are transmitted through it below to the front of the knee joint.

the inner is indistinct.

The **EXTERNAL CIRCUMFLEX ARTERY** is the chief vessel for the supply of the muscles of the front of the thigh. It arises from the outer side of the profunda (deep femoral) artery, and is directed horizontally outwards through the divisions of the anterior crural nerve, and beneath the sartorius and rectus muscles, to the under surface of the vastus externus, where it ends in branches. Offsets are given from the artery to the rectus and sartorius; and its terminal branches consist of an ascending, a transverse, and a descending set.

Artery to the muscles on the front of the thigh.

a. The *ascending branches* are about three in number, and are directed beneath the tensor vaginæ femoris to the back of the hip bone, where they anastomose with the gluteal artery.

Its branches are—

b. The *transverse* or middle set, consisting of two, and the smallest in size, perforate the vastus externus, and anastomose on the back of the thigh with the sciatic and perforating arteries.

an ascending set,

a transverse,

c. The *descending branches* are the largest, and are distributed to the vasti muscles. One considerable offset enters the vastus externus, and reaching the knee, anastomoses on it with the external articular arteries.

and a descending set.

Peculiarities in the origin of this artery are very frequent. Thus the vessel may arise as one trunk from the superficial instead of the deep femoral artery. It may be represented by two pieces, which

Varieties in this artery

and branches. may spring from one of the two femoral trunks, or may be derived from both trunks—one piece being obtained from each: this last arrangement is most frequently found.

Nerve of the front of the thigh. The ANTERIOR CRURAL NERVE is derived from the lumbar plexus (p. 599), and supplies the muscles and the integuments of the front of the thigh, and the integuments of the inner side of the leg. Soon after the trunk of the nerve leaves the abdomen it is flattened, and is divided into a superficial or cutaneous, and a deep or muscular part.

From its superficial part arise—A. The *superficial* part of the nerve ends in three branches:—the internal and the middle cutaneous of the thigh, and the great saphenous.

middle cutaneous. The *middle cutaneous nerve* perforates the fascia lata, sometimes also the sartorius, about three inches below Poupart's ligament, and extends on the surface of the thigh to the knee. Its cutaneous distribution is described at p. 674.

Internal cutaneous. The *internal cutaneous nerve* sends two or more small twigs through the fascia lata to the integument of the upper third of the thigh, and then divides in front of the femoral artery, or on the inner side, into the two following branches, anterior and inner.* Sometimes these branches in which the nerve ends ordinarily, arise from the anterior crural trunk at separate spots.

anterior and a. The *anterior branch* is directed to the inner side of the knee joint. As far as the middle of the thigh it lies over the sartorius, but it then pierces the fascia lata, and ramifies in the integuments as before said (p. 675).

inner branch. b. The *inner branch* is distributed in the integuments of the inner side of the leg, just below the knee, but it remains beneath the fascia lata as far as the knee (p. 675). Whilst underneath the fascia the nerve lies along the inner border of the sartorius, and joins in a plexus, about the middle of the thigh, with offsets of the obturator and internal saphenous nerves. When this branch is small it ends in the plexus just mentioned, and in twigs to the inner part of the thigh, instead of being continued onwards to the leg.

Internal saphenous nerve. The *internal saphenous nerve* is the largest of the three superficial branches. It becomes cutaneous on the inner side of the knee, and accompanies the vein of the same name to the foot (p. 675). In the thigh the nerve takes the course of the deep bloodvessels:—thus, it approaches the femoral artery where this is concealed by the sartorius, and is con-

* This is the arrangement most commonly met with.—See foot note to the Second Edition, p. 624.

tinued along the outer side of that vessel, beneath the aponeurosis covering the same, as far as the opening in the adductor magnus muscle. At that spot the nerve passes from beneath the aponeurosis, and is continued under the sartorius muscle to the upper part of the leg, to become cutaneous as before said. It supplies two offsets whilst it is contained in the thigh beneath the fascia.

becomes cutaneous at the knee ;

a. The *communicating branch* arises about the middle of the thigh, and crosses inwards beneath the sartorius to join the internal cutaneous and the obturator in the plexus : this branch is sometimes absent.

has a communicating

b. The *patellar branch* springs from the nerve near the knee joint, and perforating the sartorius muscle and the fascia lata, ends in the integument over the knee (p. 675).

and a patellar offset.

B. The *deep or muscular part* of the anterior crural nerve gives branches to all the muscles of the front of the thigh, except the tensor vaginae femoris ; and it supplies also an offset to one of the adductor muscles, viz., the pectineus.

From the deep part arises

Two slender *nerves* cross beneath the femoral artery, and enter the anterior surface of the *pectineus*.

branches to pectineus ;

Branches to the *sartorius* are furnished by the middle or by the internal cutaneous nerve, whilst it is in contact with that muscle.

sartorius ;

A *nerve* enters the under surface of the *rectus* muscle at the upper part, and divides into branches as it is about to penetrate the fibres.

rectus ;

The *nerve* to the *vastus externus* separates into two or more branches as it enters the muscle. From one of these an *articular filament* is continued downwards to the knee joint, which it enters on the anterior aspect.

vastus externus and knee joint ;

The *nerve* to the *vastus internus* is nearly as large in size as the internal saphenous, in common with which it often arises. To the upper part of the muscle it furnishes one or more branches, and is then continued as far as the centre of the thigh, where it ends in offsets to the muscle and the knee joint.

and vastus internus.

a. The *articular branch* is prolonged to the inner side of the knee joint on or in the vastus, and on the tendon of the adductor magnus ; and it is distributed over the synovial membrane of the front of the articulation. This small nerve accompanies the deep branch of the anastomotic artery.

Articular offset to knee.

A *branch* of nerve to the *tensor vaginae femoris* is derived from the superior gluteal (p. 709), and enters the under surface of the muscle. In the fibres it extends nearly to the lower end.

Nerve of tensor vaginae.

Take next
the adduc-
tors.

Directions.—After the examination of the muscles of the front of the thigh, with the vessels and nerves that are furnished to them, the student is to learn the adductor muscles and their vessels and nerves.

Dissection
of adductor
muscles.

Dissection.—To prepare the muscles, the investing tissue is to be taken from them, and the superficial adductors are to be separated one from another.

Nerves.

Let the student be careful of the branches of the obturator nerve in connection with the muscles, viz., those offsets entering the muscular fibres, and the plexus on the inner side of the thigh.

Remove
veins.

Lastly, should any fat and veins be left with the profunda and its branches, they must be cleared away.

DEEP PARTS ON THE INNER SIDE OF THE THIGH.

The adduc-
tor muscles
and their
position.

The muscles in this position are the three adductors,—longus, brevis, and magnus; with the gracilis and the pectineus; these have the under-mentioned position with respect to one another. Internal to all and the longest, is the gracilis. Superficial to the others, are the pectineus and the adductor longus; and beneath them are the short adductor and the adductor magnus.

Vessels.

In connection with the muscles, and supplying them are the profunda artery (of the femoral) and its branches, with the accompanying vein.

Nerve.

The obturator nerve lies amongst the adductor muscles, and furnishes branches to them.

Gracilis

takes origin
from the
pelvis,

is inserted
into tibia.

The GRACILIS reaches from the pelvis to the tibia (fig. 103, ¹¹), and is fleshy and riband-like above, but tendinous below. The muscle *arises* by an aponeurosis, two or three inches in depth, from the lower or pubic border of the hip bone close to the margin, viz., from the lower half of the symphysis, and the upper part of the pubic arch. Inferiorly it is *inserted* by a flat tendon, about half an inch wide, into the inner surface of the tibia, beneath and close to the sartorius.

Position to
other
muscles.

The muscle is superficial throughout. At the upper part of the thigh it is flattened against the adductors brevis and magnus, so as to have its borders directed forwards and backwards; and in the lower third it intervenes between the sartorius and semimembranosus muscles, and forms part of the inner boundary of the popliteal space. At its insertion the tendon is nearer the knee than that of the semitendinosus, though at the same depth from the surface, and both lie

over the internal lateral ligament ; an expansion is continued from it to the fascia of the leg, as in the tendon of the sartorius. A bursa separates it from the ligament of the joint, and projects above it to the sartorius tendon.

The PECTINEUS (fig. 103, ⁹) is the highest of the muscles directed from the pelvis to the inner side of the femur. It has a fleshy origin from the ilio-pectineal line of the hip bone, and from the triangular smooth surface in front of that line ; and it is inserted inferiorly by a tendon, about two inches in width, into the femur behind the small trochanter, and into the upper part of the line which extends from that process to the linea aspera.

Pectineus.

Origin from pubes.

inserted into femur.

The muscle is twisted, so that the surfaces which are directed forwards and backwards near the pelvis are turned inwards and outwards at the femur. One surface is in contact with the fascia lata ; and the opposite touches the obturator muscle and nerve, and the adductor brevis. The pectineus lies between the psoas and the adductor longus ; and the internal circumflex vessels pass between its outer border and the former muscle.

Muscle is twisted.

Surfaces.

Parts on the sides.

The ADDUCTOR LONGUS lies below the pectineus (fig. 103, ¹⁰), and is triangular in form, with the apex at the pelvis and the base at the femur. It arises by a narrow tendon from the front of the pubes near the angle of union of the crest and the symphysis ; and it is inserted into the inner margin of the linea aspera.

Adductor longus extends from pelvis to femur.

This muscle is situate between the gracilis and the pectineus, and forms part of the inner boundary of the triangular space containing the femoral vessels. Its anterior surface is covered near the femur by the femoral vessels and the sartorius. The posterior rests on the other two adductors, on part of the obturator nerve, and on the deep femoral artery. Aponeurotic bands connect the tendon of the muscle at its insertion with the tendons of the adductor magnus and vastus internus.

Its connections with muscles and vessels.

Dissection.—Some of the deeper muscles, with the obturator nerve and the profunda vessels, will be arrived at by reflecting the two last muscles.

Dissection of

On cutting through the pectineus near the pubes, and throwing it down, the dissector may find occasionally the small accessory nerve of the obturator which turns beneath the outer border ; if this is present, its branches to the hip joint and the obturator nerve are to be traced out. The adductor longus is then to be divided near its origin, and raised with care, so as not to destroy the branches of the

accessory obturator.

obturator nerve beneath : its tendon is to be detached also from that of the adductor magnus beneath it, to see the branches of the profunda artery.

Adductor brevis ;

and obturator nerve.

Articular nerve to knee joint.

Accessory obturator nerve

is often absent.

Adductor brevis is thin at the origin

and wide at the insertion.

Parts in front,

behind,

and at upper border.

Obturator nerve

Now the adductor brevis will be laid bare. A part of the obturator nerve crosses over this muscle to enter the plexus at the inner side of the thigh, and a deeper part of the same nerve lies beneath it. The muscle should be separated from the subjacent adductor magnus, where the lower branch of the nerve and an artery issue. In this last step of the dissection the student should seek a small articular branch of the obturator nerve, which descends on and in the fibres of the adductor magnus to the knee joint.

The *accessory obturator nerve** (Schmidt) is derived from the trunk of the obturator near the lumbar plexus (p. 600), and passes from the abdomen over the brim of the pelvis. In the thigh (fig. 91,⁶) this branch turns beneath the pectineus and joins the superficial part of the obturator nerve ; it supplies an offset to the hip joint with the articular artery, and occasionally one to the under surface of the pectineus. When the nerve is small, one or more of these offsets are wanting.

The ADDUCTOR BREVIS has a thin fleshy and aponeurotic attachment about two inches in depth to the front of the hip bone with the gracilis. The muscle *arises* from the pubic border of the bone close to and outside the gracilis ; but it reaches upwards rather higher than the muscle with which it is conjoined, viz., as high as the adductor longus, and not quite so low as the gracilis. It is *inserted* behind the pectineus into the whole of the line leading from the linea aspera towards the small trochanter.

In front of the muscle are the pectineus and the adductor longus, with the superficial piece of the obturator nerve, and the profunda artery. It is gradually uncovered by the adductor longus below, and the contiguous borders of the two are side by side at their insertion into the femur. Behind the muscle is the adductor magnus, with the deep piece of the obturator nerve. In contact with the upper border is the obturator externus, and the internal circumflex artery passes between the two.

The OBTURATOR NERVE is a branch of the lumbar plexus

* This small nerve is often absent ; it was found only four or five times in nine or ten bodies which were examined by its discoverer. The name given to it by Schmidt refers to this irregularity, viz., *nerv. ad obturatorem accessorius inconstans*.—*Commentarius de Nervis Lumbalibus*.

(p. 599), and supplies the adductor muscles of the thigh, as well as the hip and knee joints. The nerve issues from the pelvis through the aperture in the upper part of the thyroid foramen; and it divides in that opening into two parts, which are named superficial and deep from their position with respect to the adductor brevis muscle.

The *anterior* or *superficial* part of the nerve joins the plexus of the internal cutaneous and saphenous nerves at the inner aspect of the thigh (p. 694). The nerve is directed over the adductor brevis, but beneath the pectineus and the adductor longus. At the lower border of the last muscle it furnishes an offset to join in the interlacement of the nerves, but the remainder of it is continued to the femoral artery, on which it is distributed. In addition to the branches before mentioned, the nerve supplies the hip joint and some of the surrounding muscles, and receives (sometimes) the communicating twig from its accessory branch.

a. Near the pelvis or in the aperture of exit, the nerve sends outwards an *articular* twig to the hip joint, with the artery to the same part.

b. *Muscular* branches are furnished to the adductor longus, the adductor brevis, and the gracilis.

Unusual condition of the nerve.—In some bodies this superficial part of the nerve is of large size, and extends beyond the plexus in the middle of the thigh. In such instances it joins freely in the plexus, and gives cutaneous offsets to the integuments of the thigh; it is continued afterwards along the inner border of the sartorius to the side of the knee, where it perforates the fascia to end in the integuments. It has a distribution similar to that of the inner branch of the internal cutaneous nerve (p. 694), whose place it takes.

The *posterior* or *deep* part of the obturator nerve pierces the fibres of the external obturator muscle, and is continued beneath the adductor brevis to be distributed chiefly in the adductor magnus. Offsets are given from it to the contiguous muscles, and one to supply the knee joint.

a. *Muscular* branches enter the obturator externus as the nerve pierces it; others are furnished to the large, and sometimes also to the short adductor.

b. A slender *articular* branch enters the fibres of the adductor magnus towards the lower part, and passes through it near the linea aspera to reach the popliteal artery, by which it is conducted to the back of the knee joint: its termination is seen in the dissection of the popliteal space.

Dissection.—To prepare the profunda artery and its

is divided into two.

The superficial part

joins plexus in the thigh,

ends on femoral artery.

Branches are to hip joint.

Muscular to adductors.

This part may be large

and extend to the knee.

Deep part of the nerve

ends in adductor magnus,

and gives branch to knee joint.

Dissect profunda.

SECTION II.

THE BUTTOCK, OR THE GLUTEAL REGION.

Position.—During the dissection of the back of the thigh the body is placed with the face down; and the pelvis is to be raised by blocks until the lower limbs hang almost vertically over the end of the dissecting table.

Directions.—Both this Section and the following one are to be gone through in the time appointed for the body to lie in its present position.

When the body is turned, the student can better recognise the points of bone marking posteriorly the limit between the thigh and the abdomen (p. 668).

Dissection.—The integument is to be raised from the buttock by means of the following incisions:—One is to be made along the iliac crest of the hip bone, and is to be continued in the middle line of the sacrum to the tip of the coccyx. Another is to be begun where the first terminates, and is to be carried outwards and downwards across the thigh till it is about six inches below the great trochanter. The flap of skin thus marked out above and below is to be thrown down.

Some of the cutaneous nerves of this region will be found in the fat or beneath it along the line of the iliac crest. Beginning in front, the student will meet first with branches of the external cutaneous rather below the crest, if these have not been cut before. Crossing the crest near the front, is an offset of the last dorsal nerve; and farther back another from the ilio-hypogastric nerve; whilst in a line with the outer border of the erector spinæ in the back are two or three branches of the lumbar nerves. By the side of the sacrum and coccyx are two or three offsets of the sacral nerves.

The remaining cutaneous nerves are derived from the small sciatic, and must be sought beneath the fat along the line of the lower incision, where they come from underneath the gluteus maximus. A few turn upwards over that muscle, and the rest are directed down to the thigh.

CUTANEOUS NERVES.—The nerves distributed in the integuments of the buttock are small but numerous, and are derived from the spinal nerves (posterior primary branches), from the branches of the lumbar and sacral plexuses, and from the last dorsal nerve.

From the posterior branches of the lumbar and sacral nerves.—*a.* The offsets of the posterior primary branches of the lumbar nerves are two or three in number, and cross the crest of the hip bone near the anterior edge of the erector spinæ: they ramify in the integuments covering the gluteus muscle, and some branches may be traced nearly to the trochanter major. From lumbar

The branches of the sacral nerves perforate the gluteus maximus near the origin, and are then directed outwards for a short distance in the integuments over the muscle. These offsets are usually three in number; the largest is opposite the lower end of the sacrum, another is near the iliac crest, and the other by the side of the coccyx. and sacral nerves.

Nerves from the lumbar plexus.—Parts of two nerves from the lumbar plexus, viz. ilio-hypogastric and external cutaneous, are spent in the integuments of this region. From lumbar plexus.

a. The iliac branch of the ilio-hypogastric nerve crosses the iliac crest in front of the branches from the lumbar nerves, and extends only a short distance below the crest: this branch is very variable in size, or it may be wanting. through ilio-hypogastric, and

b. Offsets of the external cutaneous nerve of the thigh bend backwards to the integuments above the great trochanter, and cross the ramifications of the branch of the last dorsal nerve. external cutaneous.

Nerves from the sacral plexus.—Only one nerve of the plexus, viz. the small sciatic, sends superficial branches to the buttock. Its cutaneous offsets appear along the lower border of the gluteus maximus, and are accompanied by superficial branches of the sciatic artery; two or three ascend round the edge of the muscle, and are lost in the integuments over the lower part; the remaining branches descend to the thigh, and will be afterwards noticed on it. From sacral plexus, through small sciatic.

The last dorsal nerve supplies the buttock by means of its lateral cutaneous branch (p. 479). This offset perforates the muscles of the abdomen, and crosses the anterior part of the iliac crest to be distributed over the fore part of the gluteal region, as low as the great trochanter. From last dorsal nerve.

Dissection.—In the examination of this region the thin and unimportant deep fascia may be disregarded, in order that the great gluteal muscle, which is the most difficult in the body to make clean, may be well displayed. Supposing the student desirous to lay bare the muscle at once, let him turn aside the cutaneous nerves, and draw away and rotate inwards the limb to make tense the muscular fibres. Having cut through the fat and fascia from the upper to the lower Clean gluteus maximus.
Mode of proceeding.

border of the muscle, let him carry the scalpel along one bundle of fibres at a time in the direction of a line from the sacrum to the femur, until all the coarse fasciculi are cleaned. If the student has a right limb, the dissection may be begun at the upper border; but if a left limb, at the lower margin of the muscle.

Fascia of the buttock is thin and unimportant.

The *fascia of the buttock* is a prolongation of that enveloping the thigh, and is fixed to the crest of the hip bone, and to the sacrum and coccyx. It is much thicker in front of than on the gluteus maximus, and gives attachment anteriorly to the gluteus medius which it covers. At the edge of the gluteus maximus the fascia is slit to incase it.

Gluteus maximus

The **GLUTEUS MAXIMUS** is the most superficial muscle of the buttock, and reaches from the pelvis to the upper part of the femur. Its origin from the pelvis is partly osseous and partly aponeurotic:—Thus, the muscle is attached from above down to the posterior third of the iliac crest, and to a special impression on the hip bone below the crest; next, to the aponeurosis covering the multifidus spinæ muscle; and lastly to the back of the lowest piece of the sacrum, and to the side of the coccyx with the great sacro-sciatic ligament.

Origin above from pelvis;

inserted below into the femur.

From this origin the fibres are directed outwards to their *insertion*:—About two thirds of the upper fibres and a few of the lowest fibres end in the fascia lata of the outer part of the thigh. The remainder are fixed for three inches into the lower part of the line leading from the linea aspera to the great trochanter of the femur.

Connections of the surfaces

The gluteus forms the prominence of the buttock, and resembles the deltoid muscle of the arm in its situation and in the coarseness of its texture. Its cutaneous surface is covered by the common investing fasciæ of the limb, and by the superficial nerves. The parts in contact with the under surface will be seen when the muscle is cut through. The

and borders.

upper border overlays the gluteus medius. And the lower border, which is longer and thicker than the upper, forms the fold of the nates and bounds posteriorly the perineal space; beneath the lower border the hamstring muscles and the sciatic vessels and nerves are placed.

Divide the gluteus maximus.

Dissection.—The gluteus maximus is to be cut across near the pelvis but external to the sacral nerves perforating it, and without injuring the subjacent sacro-sciatic ligament to which the lower fibres are closely joined. The depth of the muscle will be ascertained by the fascia beneath it, and by some vessels. When this intermuscular layer is arrived at, the outer part of the gluteus is to be thrown towards its

insertion, and the sciatic artery and nerves are to be detached from the under surface, though the branches that enter the muscle must be cut.

The loose fat is to be taken away from the hollow between the pelvis and the trochanter, without injuring the vessels and nerves; and the several muscles are to be cleaned, the fibres of each being made tense at the time of its dissection by rotating the femur. In removing the areolar tissue from the ischial tuberosity and the great trochanter, the bursa on each prominence of bone should be observed.

The vessels, nerves, and muscles of this region which are to be defined are noticed below in the enumeration of the parts beneath the gluteus.

Lastly the origin of the muscle is to be removed. And the sacral nerves, when dissected out of the gluteus, are to be followed to the surface of the great sacro-sciatic ligament, where they are united, and concealed by aponeurotic fibres.

Parts beneath the gluteus.—At its origin the gluteus maximus rests on the pelvis, and conceals parts of the hip bone, sacrum, and coccyx: above, the muscle covers also the ischial tuberosity with the origin of the hamstring muscles, and the great sacro-sciatic ligament. At its insertion it covers the upper end of the femur, with the great trochanter and the origin of the vastus externus. Between the muscle and each prominence of bone, viz. the tuberosity and the trochanter, is a large, loose synovial membrane; and between it and the vastus externus is another synovial sac.

In the hollow between the pelvis and the femur the muscle conceals, from above downwards, the undermentioned parts:—First is a portion of the gluteus medius; and below it is the pyriformis, with the superficial branch of the gluteal artery between the two. Coming from beneath the pyriformis are the sciatic vessels, and the large and small sciatic nerves, which descend to the thigh between the great trochanter and the ischial tuberosity; and internal to these are the pudic vessels and nerve, and the nerve to the obturator internus muscle, which are directed inwards through the small sacro-sciatic notch. Still lower down is the tendon of the obturator internus muscle, with a fleshy fasciculus—the gemellus—above and below it. Next come the thin quadratus femoris muscle, and the upper part of the adductor magnus. At the upper border of the quadratus is the tendon of the obturator externus; and at the lower border, between it and the adductor, is one of the terminal branches of the internal circumflex artery.

The external branches of sacral nerves are united beneath gluteus.

Sacral nerves.—The external offsets of the posterior primary branches of the first three sacral nerves, after passing outwards beneath the multifidus spinæ (p. 437), are joined by loops on the surface of the great sacro-sciatic ligament. Two or three cutaneous offsets are derived from this intercommunication, and pierce the fibres of the gluteus maximus to be distributed on the surface (p. 705).

Gluteus medius

arises from hip bone,

and inserted into trochanter.

Connections.

Detach gluteus medius to see gluteal vessels

and nerve.

Gluteal artery is divided into two.

Superficial branch.

Deep branch :

The GLUTEUS MEDIUS is triangular in form, with its base at the innominate bone, and its apex at the femur. It *arises* chiefly from the outer surface of the hip bone between the crest and the superior curved line, except behind where the gluteus maximus is attached, and where there is a surface of bone free from muscular fibres ; and many fibres arise also from the strong fascia covering the anterior part of the muscle. The fibres of origin converge to a tendon which is *inserted* into an impression across the outer surface of the great trochanter, extending from the tip behind to the root in front.

The superficial surface is concealed in part by the gluteus maximus ; and the deep is in contact with the gluteus minimus and the gluteal vessels and nerve. The anterior border lies over the gluteus minimus, and is in contact with the tensor of the fascia lata. The posterior is contiguous to the pyriformis, only the gluteal artery intervening. A small bursa is between the tendon of insertion and the trochanter.

Dissection.—When the gluteus medius is detached from the pelvis, and partly separated from the gluteus minimus beneath, the gluteal vessels and nerve will come into view. The two chief branches of the artery,—one being near the iliac crest, and the other lower down,—are to be traced through the fleshy fibres as the reflection of the gluteus is proceeded with ; and the main part of the nerve is to be followed on at the same time to the tensor vaginæ femoris muscle. A branch of the artery to the gluteus maximus must be cut in removing that muscle.

The *gluteal artery* is the largest branch of the internal iliac (p. 622), and issues from the pelvis above the pyriformis muscle. On the dorsum of the hip bone it ends in offsets which supply the gluteal muscles and the bone, and anastomose with the other branches in this situation. Its named branches are superficial and deep :—

a. The *superficial branch* sends inwards a few twigs over the sacrum, and ends in the gluteus maximus, into which it penetrates on the under surface.

b. The *deep branch* is the continuation of the artery, and

lies between the two smaller gluteal muscles: it subdivides into two pieces. One (superior) courses along the origin of the gluteus minimus to the front of the iliac crest, where it anastomoses with the ascending branches of the external circumflex artery. The other portion (inferior) is directed forwards over the middle of the smallest gluteal muscle with the nerve, towards the anterior lower iliac spine and the great trochanter, and communicates also with the external circumflex branches. Some offsets pierce the muscle to supply the hip-joint.

this has an upper and a lower piece.

Vein.—The companion vein of this artery enters the pelvis, and ends in the internal iliac vein.

Gluteal vein.

The *superior gluteal nerve* is a branch of the lumbo-sacral cord (p. 597). It accompanies the gluteal artery, and divides into branches for the supply of the two smallest gluteal muscles: its lowest branch may be traced forwards into the tensor vaginæ femoris.

Superior gluteal nerve is muscular.

The GLUTEUS MINIMUS is likewise conical in shape, and arises from the dorsum of the hip bone between the superior and inferior curved lines, extending downwards as far as the middle of the hip joint.* The fibres are collected on a tendon, which is inserted into an impression along the fore part of the great trochanter, and is united inferiorly with the gluteus medius.

Gluteus minimus.

Attachments.

One surface is in contact with the gluteus medius, and the gluteal vessels and nerve; the other with the hip joint and the bone, and the outer head of the rectus femoris muscle. The anterior border lies by the side of the other gluteus; and the posterior touches the pyriformis muscle. A bursa is placed between the tendon and the bone.

It is next the bone,

and is joined with preceding.

Dissection.—The smallest gluteal muscle may be cut through near the innominate bone, and the tendinous part of the rectus femoris underneath it should be defined close above the hip joint. Whilst detaching the gluteus from the parts beneath, the student cannot fail to notice the connection between its tendon and the capsule of the joint. The deep vessels to the articulation may be observed and followed after the muscle is removed.

Divide smallest gluteus.

The *outer head* of the *rectus femoris* is a slip of tendon about two inches long, which reaches outwards almost horizontally, and is fixed into the groove above the margin of the acetabulum. In front it joins the other tendinous piece of

Outer head of the rectus; where attached.

* Its extent is greater than that given usually to the muscle. For the limit of the lower line see the description of the hip bone in Quain's *Anatomy*, vol. i. p. 138 (Edition of 1856).

	branches, supposing the veins and the fat removed, it will be requisite to follow backwards the internal circumflex artery above the upper border of the adductor brevis, and to trace the perforating branches through the tendons of the adductors near the femur.
Profunda artery,	The PROFUNDA (deep femoral) is the chief muscular artery of the thigh, and arises from the femoral trunk about one inch and a half below Poupart's ligament (p. 685). At its origin the vessel is placed on the outer side of the parent trunk. It is then directed inwards beneath the femoral vessels to the inner side of the femur, and ends at the lower third of the thigh in a small branch that pierces the adductor magnus. Where the vessel lies in the triangular space of the thigh (near its origin) it rests on the iliacus muscle. But on the inner side of the femur it lies parallel to the femoral artery, though deeper in position; and it is placed first over the adductor brevis, and thence to its termination between the adductors longus and magnus.
origin,	
course,	
and ending.	
Parts around.	
Branches to muscles of the thigh join freely.	Its <i>branches</i> are numerous to the surrounding muscles and the bone, and maintain free anastomoses with other vessels supplied to the upper part of the thigh, as well as with those of the leg. It is through these communications that the blood finds its way to the lower part of the limb when the tube of the chief artery is obliterated either above or below the origin of the profunda. The branches to the adductor muscles are unnamed. The named branches are these:—external circumflex to the extensor muscles of the knee; internal circumflex round the inner side of the femur to the back of the thigh; and perforating arteries through the adductors to the back of the limb and the extensor muscle of the knee joint.
The named branches are—	
external circumflex;	The <i>external circumflex</i> artery has been described in the dissection of the muscles of the front of the thigh (p. 693).
internal circumflex;	The <i>internal circumflex</i> branch arises from the inner or posterior part of the profunda, and turns backwards between the psoas and pectineus, but above the border of the adductor brevis, along the side of the tendon of the external obturator muscle. Having reached the back of the thigh, it ends in two branches, which will be seen in the dissection of the buttock (714). It supplies the undermentioned branches to the inner side of the thigh:—
ends on back of thigh,	
supplies hip joint and	a. An <i>articular</i> artery enters the hip joint through the notch in the acetabulum.
muscles.	b. At the border of the adductor brevis two <i>muscular</i> branches arise:—one ascends to the obturator and the super-

ficial adductor muscles ; the other, which is larger, descends beneath the adductor brevis, and ends in this and the largest adductor.

The origin of the internal circumflex is very variable. In one body it may be from the femoral artery above the profunda ; in another from the external iliac artery, or from the epigastric and circumflex iliac branches.

The *perforating branches* are usually three in number, and pierce the tendons of some of the adductor muscles close to the linea aspera of the femur. They supply the muscles on the back and outer part of the thigh ; and anastomose above with branches of the internal iliac, as well as below with those of the popliteal artery.

a. The *first* is opposite the lower border of the pectineus, and perforates the short and large adductors.

b. The *second* branch arises lower down, and passes through the same muscles as the preceding : from it a *nutritious* vessel is supplied to the femur.

c. The *third* artery springs from the deep femoral trunk below the adductor brevis, and is transmitted through the adductor magnus.

d. The terminal branch of the profunda (fourth perforating) pierces the adductor magnus.

The PROFUNDA VEIN results from the union of the different branches corresponding with the offsets of its companion artery. It accompanies closely the artery of the same name, to which it is superficial. Sometimes the vein is suddenly enlarged at the upper part by the union of a large trunk from the popliteal vein, which is directed upwards at first behind, and then through the adductor magnus.

Dissection.—To bring into view the remaining muscles, viz., the adductor magnus, the obturator externus, and the insertion of the psoas and iliacus, the adductor brevis is to be cut through, and the investing layer of areolar tissue is to be removed from each. After the adductor magnus has been learnt, it will be needful to detach a few of the upper fibres to examine the obturator externus.

The ADDUCTOR MAGNUS is narrow at the pelvis, and wide at the femur. Triangular in form its base is directed upwards, whilst one side is attached to the femur and the other is free at the inner part of the thigh.

The muscle arises from the part of the innominate bone corresponding with the pubic arch, reaching from the lower border of the symphysis to the lower part of the ischial tuberosity. The anterior fibres diverge from their origin,

Origin variable.

Three perforating branches.

First.

Second gives nutritious artery.

Third.

And the ending is a fourth.

Profunda vein

is sometimes joined by popliteal.

Cut through adductor brevis.

Adductor magnus ;

origin is narrow ;

fibres diverge to their insertion,

some being horizontal,

others vertical,

and form two parts.

Connections of the anterior and posterior surface.

Upper and lower borders.

Insertion into femur.

Opening for the vessels ;

boundaries.

Psoas and iliacus in the thigh.

Insertion into femur.

Parts around.

and construct almost a distinct part: they are horizontal above, but become more oblique below, and are *inserted* (from above down) into the lower end of the linea quadrati, and into part of the line continued from the great trochanter to the linea aspera; into all the linea aspera; and into a small part of the line leading from that crest of bone to the inner condyle of the femur. The posterior fibres from the ischial tuberosity are vertical in direction, and end about the lower third of the thigh in a tendon, which is inserted into the inner condyle of the femur, and is connected by a fibrous expansion to the line leading upwards from that point of bone to the linea aspera.

The muscle consists of the two parts above described, which differ in their characters. The anterior or upper one, thin and fleshy, forms a septum between the other adductors and the muscles on the back of the thigh; but the inner or posterior piece, partly fleshy and partly tendinous, constitutes the inner thick margin of the muscle. On the anterior surface are the other two adductor muscles and the pectineus, with the obturator nerve and the profunda artery. The posterior surface is in connection with the hamstring muscles and the great sciatic nerve. In contact with the upper border are the obturator externus and the quadratus femoris, with the internal circumflex artery; and along the lower or inner border are the gracilis and the sartorius. At its attachment to the femur the muscle is closely united with the other adductors, particularly the adductor longus, and is there pierced by apertures for the passage of the femoral and perforating arteries.

The *opening* in the adductor for the transmission of the femoral vessels into the popliteal space is tendinous at the anterior, but fleshy at the posterior aspect. It is situate at the point of junction of the middle with the lower third of the thigh, and is larger than is necessary for the passage of the vessels. On the outside it is bounded by the vastus internus; and on the inside by the tendon of the adductor magnus, with some fibres added from the tendon of the long adductor.

The PSOAS and ILLIACUS arise separately in the abdomen (p. 593), but are united in the thigh. The conjoined portion of the muscles comes beneath Poupart's ligament, and is *inserted* by a tendon into the small trochanter of the femur, as well as by fleshy fibres into a special triangular surface of the bone in front of and below that eminence.

Beneath the ligament the muscles occupy the interval

between the ilio-pectineal eminence and the anterior superior iliac spinous process,—the iliacus resting on a small bursa; and below the pelvis the mass covers the capsule of the hip joint and a larger intervening bursa. On the front of the psoas is the femoral artery, and between the two muscles lies the anterior crural nerve. The pectineus and the internal circumflex artery are contiguous to the inner border; and the sartorius and vastus internus touch the outer edge.

The OBTURATOR EXTERNUS is triangular in form, with the base at the pelvis and the apex at the femur. The fibres of the muscle take *origin* from the outer surface of the obturator membrane for the anterior half; and from the inner half or more of the bony circumference of the thyroid foramen, the attachment being an inch wide opposite the symphysis pubis, but lower down only half that width. From the origin the fibres are directed obliquely outwards and backwards to be *inserted* by a tendon into the pit at the root of the great trochanter.

This muscle is concealed by the pectineus, adductor brevis, and adductor magnus. It covers the obturator membrane and artery, and is pierced by part of the obturator nerve. As it courses backwards it is in contact with the inner and lower parts of the hip joint. The insertion of the muscle will be seen in the dissection of the buttock.

Dissection.—By detaching a small part of the obturator muscle from the pelvis, the branches of the artery and nerve of the same name will be seen amongst its fibres. Less injury will be done to the part if the dissection of the vessel and nerve is deferred till after the limb is detached.

The *obturator artery* is a branch of the internal iliac in the pelvis (p. 622), and enters the thigh through the upper part of the thyroid foramen. Whilst in its aperture the artery divides into two parts, which inosculate, and form a circle beneath the muscle around the obturator membrane.

The *upper* branch extends along the inner half of the membrane, and anastomoses inferiorly with the other. The *lower* perforates the membrane below the upper branch, and turns downwards to form a circle by uniting with it. An *articular* twig to the hip joint is supplied from the lower branch.

Offsets of the obturator artery are furnished to the obturator muscles; and some small twigs extend to the upper part of the adductors.

Branches of nerve to the obturator muscle come from the deep portion of the obturator trunk, and perforate the membrane with the lower branch of the artery.

SECTION II.

THE BUTTOCK, OR THE GLUTEAL REGION.

Position of the body. *Position.*—During the dissection of the back of the thigh the body is placed with the face down; and the pelvis is to be raised by blocks until the lower limbs hang almost vertically over the end of the dissecting table.

Directions. *Directions.*—Both this Section and the following one are to be gone through in the time appointed for the body to lie in its present position.

When the body is turned, the student can better recognise the points of bone marking posteriorly the limit between the thigh and the abdomen (p. 668).

Take up the skin. *Dissection.*—The integument is to be raised from the buttock by means of the following incisions:—One is to be made along the iliac crest of the hip bone, and is to be continued in the middle line of the sacrum to the tip of the coccyx. Another is to be begun where the first terminates, and is to be carried outwards and downwards across the thigh till it is about six inches below the great trochanter. The flap of skin thus marked out above and below is to be thrown down.

Cutaneous nerves above. Some of the cutaneous nerves of this region will be found in the fat or beneath it along the line of the iliac crest. Beginning in front, the student will meet first with branches of the external cutaneous rather below the crest, if these have not been cut before. Crossing the crest near the front, is an offset of the last dorsal nerve, and farther back another from the ilio-hypogastric nerve; whilst in a line with the outer border of the erector spinæ in the back are two or three branches of the lumbar nerves. By the side of the sacrum and coccyx are two or three offsets of the sacral nerves.

Other nerves of small sciatic below. The remaining cutaneous nerves are derived from the small sciatic, and must be sought beneath the fat along the line of the lower incision, where they come from underneath the gluteus maximus. A few turn upwards over that muscle, and the rest are directed down to the thigh.

Sources of the cutaneous nerves. *CUTANEOUS NERVES.*—The nerves distributed in the integuments of the buttock are small but numerous, and are derived from the spinal nerves (posterior primary branches), from the branches of the lumbar and sacral plexuses, and from the last dorsal nerve.

From the posterior branches of the lumbar and sacral nerves.—*a.* The offsets of the posterior primary branches of the lumbar nerves are two or three in number, and cross the crest of the hip bone near the anterior edge of the erector spinæ: they ramify in the integuments covering the gluteus muscle, and some branches may be traced nearly to the trochanter major.

From lumbar

The branches of the sacral nerves perforate the gluteus maximus near the origin, and are then directed outwards for a short distance in the integuments over the muscle. These offsets are usually three in number; the largest is opposite the lower end of the sacrum, another is near the iliac crest, and the other by the side of the coccyx.

and sacral nerves.

Nerves from the lumbar plexus.—Parts of two nerves from the lumbar plexus, viz. ilio-hypogastric and external cutaneous, are spent in the integuments of this region.

From lumbar plexus.

a. The iliac branch of the ilio-hypogastric nerve crosses the iliac crest in front of the branches from the lumbar nerves, and extends only a short distance below the crest: this branch is very variable in size, or it may be wanting.

through ilio-hypogastric, and

b. Offsets of the external cutaneous nerve of the thigh bend backwards to the integuments above the great trochanter, and cross the ramifications of the branch of the last dorsal nerve.

external cutaneous.

Nerves from the sacral plexus.—Only one nerve of the plexus, viz. the small sciatic, sends superficial branches to the buttock. Its cutaneous offsets appear along the lower border of the gluteus maximus, and are accompanied by superficial branches of the sciatic artery; two or three ascend round the edge of the muscle, and are lost in the integuments over the lower part; the remaining branches descend to the thigh, and will be afterwards noticed on it.

From sacral plexus, through small sciatic.

The last dorsal nerve supplies the buttock by means of its lateral cutaneous branch (p. 479). This offset perforates the muscles of the abdomen, and crosses the anterior part of the iliac crest to be distributed over the fore part of the gluteal region, as low as the great trochanter.

From last dorsal nerve.

Dissection.—In the examination of this region the thin and unimportant deep fascia may be disregarded, in order that the great gluteal muscle, which is the most difficult in the body to make clean, may be well displayed. Supposing the student desirous to lay bare the muscle at once, let him turn aside the cutaneous nerves, and draw away and rotate inwards the limb to make tense the muscular fibres. Having cut through the fat and fascia from the upper to the lower

Clean gluteus maximus.

Mode of proceeding.

border of the muscle, let him carry the scalpel along one bundle of fibres at a time in the direction of a line from the sacrum to the femur, until all the coarse fasciculi are cleaned. If the student has a right limb, the dissection may be begun at the upper border; but if a left limb, at the lower margin of the muscle.

Fascia of the buttock is thin and unimportant.

The *fascia of the buttock* is a prolongation of that enveloping the thigh, and is fixed to the crest of the hip bone, and to the sacrum and coccyx. It is much thicker in front of than on the gluteus maximus, and gives attachment anteriorly to the gluteus medius which it covers. At the edge of the gluteus maximus the fascia is slit to incise it.

Gluteus maximus

The GLUTEUS MAXIMUS is the most superficial muscle of the buttock, and reaches from the pelvis to the upper part of the femur. Its origin from the pelvis is partly osseous and partly aponeurotic:—Thus, the muscle is attached from above down to the posterior third of the iliac crest, and to a special impression on the hip bone below the crest; next, to the aponeurosis covering the multifidus spinæ muscle; and lastly to the back of the lowest piece of the sacrum, and to the side of the coccyx with the great sacro-sciatic ligament. From this origin the fibres are directed outwards to their

inserted below into the femur.

insertion:—About two thirds of the upper fibres and a few of the lowest fibres end in the fascia lata of the outer part of the thigh. The remainder are fixed for three inches into the lower part of the line leading from the linea aspera to the great trochanter of the femur.

Connections of the surfaces

The gluteus forms the prominence of the buttock, and resembles the deltoid muscle of the arm in its situation and in the coarseness of its texture. Its cutaneous surface is covered by the common investing fasciæ of the limb, and by the superficial nerves. The parts in contact with the under surface will be seen when the muscle is cut through. The

and borders.

upper border overlays the gluteus medius. And the lower border, which is longer and thicker than the upper, forms the fold of the nates and bounds posteriorly the perineal space; beneath the lower border the hamstring muscles and the sciatic vessels and nerves are placed.

Divide the gluteus maximus.

Dissection.—The gluteus maximus is to be cut across near the pelvis but external to the sacral nerves perforating it, and without injuring the subjacent sacro-sciatic ligament to which the lower fibres are closely joined. The depth of the muscle will be ascertained by the fascia beneath it, and by some vessels. When this intermuscular layer is arrived at, the outer part of the gluteus is to be thrown towards its

insertion, and the sciatic artery and nerves are to be detached from the under surface, though the branches that enter the muscle must be cut.

The loose fat is to be taken away from the hollow between the pelvis and the trochanter, without injuring the vessels and nerves; and the several muscles are to be cleaned, the fibres of each being made tense at the time of its dissection by rotating the femur. In removing the areolar tissue from the ischial tuberosity and the great trochanter, the bursa on each prominence of bone should be observed.

The vessels, nerves, and muscles of this region which are to be defined are noticed below in the enumeration of the parts beneath the gluteus.

Lastly the origin of the muscle is to be removed. And the sacral nerves, when dissected out of the gluteus, are to be followed to the surface of the great sacro-sciatic ligament, where they are united, and concealed by aponeurotic fibres.

Parts beneath the gluteus.—At its origin the gluteus maximus rests on the pelvis, and conceals parts of the hip bone, sacrum, and coccyx: above, the muscle covers also the ischial tuberosity with the origin of the hamstring muscles, and the great sacro-sciatic ligament. At its insertion it covers the upper end of the femur, with the great trochanter and the origin of the vastus externus. Between the muscle and each prominence of bone, viz. the tuberosity and the trochanter, is a large, loose synovial membrane; and between it and the vastus externus is another synovial sac.

In the hollow between the pelvis and the femur the muscle conceals, from above downwards, the undermentioned parts:—First is a portion of the gluteus medius; and below it is the pyriformis, with the superficial branch of the gluteal artery between the two. Coming from beneath the pyriformis are the sciatic vessels, and the large and small sciatic nerves, which descend to the thigh between the great trochanter and the ischial tuberosity; and internal to these are the pudic vessels and nerve, and the nerve to the obturator internus muscle, which are directed inwards through the small sacro-sciatic notch. Still lower down is the tendon of the obturator internus muscle, with a fleshy fasciculus—the gemellus—above and below it. Next come the thin quadratus femoris muscle, and the upper part of the adductor magnus. At the upper border of the quadratus is the tendon of the obturator externus; and at the lower border, between it and the adductor, is one of the terminal branches of the internal circumflex artery.

Clean parts beneath.

Dissect out sacral nerves.

Parts covered by gluteus at its origin

and insertion;

and by the intervening part of the muscle.

The external branches of sacral nerves are united beneath gluteus.

Sacral nerves.—The external offsets of the posterior primary branches of the first three sacral nerves, after passing outwards beneath the multifidus spinæ (p. 437), are joined by loops on the surface of the great sacro-sciatic ligament. Two or three cutaneous offsets are derived from this intercommunication, and pierce the fibres of the gluteus maximus to be distributed on the surface (p. 705).

Gluteus medius

arises from hip bone,

and inserted into trochanter.

Connections.

Detach gluteus medius to see gluteal vessels

and nerve.

Gluteal artery is divided into two.

Superficial branch.

Deep branch :

The **GLUTEUS MEDIUS** is triangular in form, with its base at the innominate bone, and its apex at the femur. It arises chiefly from the outer surface of the hip bone between the crest and the superior curved line, except behind where the gluteus maximus is attached, and where there is a surface of bone free from muscular fibres ; and many fibres arise also from the strong fascia covering the anterior part of the muscle. The fibres of origin converge to a tendon which is inserted into an impression across the outer surface of the great trochanter, extending from the tip behind to the root in front.

The superficial surface is concealed in part by the gluteus maximus ; and the deep is in contact with the gluteus minimus and the gluteal vessels and nerve. The anterior border lies over the gluteus minimus, and is in contact with the tensor of the fascia lata. The posterior is contiguous to the pyriformis, only the gluteal artery intervening. A small bursa is between the tendon of insertion and the trochanter.

Dissection.—When the gluteus medius is detached from the pelvis, and partly separated from the gluteus minimus beneath, the gluteal vessels and nerve will come into view. The two chief branches of the artery,—one being near the iliac crest, and the other lower down,—are to be traced through the fleshy fibres as the reflection of the gluteus is proceeded with ; and the main part of the nerve is to be followed on at the same time to the tensor vaginæ femoris muscle. A branch of the artery to the gluteus maximus must be cut in removing that muscle.

The *gluteal artery* is the largest branch of the internal iliac (p. 622), and issues from the pelvis above the pyriformis muscle. On the dorsum of the hip bone it ends in offsets which supply the gluteal muscles and the bone, and anastomose with the other branches in this situation. Its named branches are superficial and deep :—

a. The *superficial* branch sends inwards a few twigs over the sacrum, and ends in the gluteus maximus, into which it penetrates on the under surface.

b. The *deep* branch is the continuation of the artery, and

lies between the two smaller gluteal muscles : it subdivides into two pieces. One (superior) courses along the origin of the gluteus minimus to the front of the iliac crest, where it anastomoses with the ascending branches of the external circumflex artery. The other portion (inferior) is directed forwards over the middle of the smallest gluteal muscle with the nerve, towards the anterior lower iliac spine and the great trochanter, and communicates also with the external circumflex branches. Some offsets pierce the muscle to supply the hip-joint.

Vein.—The companion vein of this artery enters the pelvis, and ends in the internal iliac vein.

The *superior gluteal nerve* is a branch of the lumbo-sacral cord (p. 597). It accompanies the gluteal artery, and divides into branches for the supply of the two smallest gluteal muscles : its lowest branch may be traced forwards into the tensor vaginæ femoris.

The GLUTEUS MINIMUS is likewise conical in shape, and arises from the dorsum of the hip bone between the superior and inferior curved lines, extending downwards as far as the middle of the hip joint.* The fibres are collected on a tendon, which is inserted into an impression along the fore part of the great trochanter, and is united inferiorly with the gluteus medius.

One surface is in contact with the gluteus medius, and the gluteal vessels and nerve ; the other with the hip joint and the bone, and the outer head of the rectus femoris muscle. The anterior border lies by the side of the other gluteus ; and the posterior touches the pyriformis muscle. A bursa is placed between the tendon and the bone.

Dissection.—The smallest gluteal muscle may be cut through near the innominate bone, and the tendinous part of the rectus femoris underneath it should be defined close above the hip joint. Whilst detaching the gluteus from the parts beneath, the student cannot fail to notice the connection between its tendon and the capsule of the joint. The deep vessels to the articulation may be observed and followed after the muscle is removed.

The *outer head* of the *rectus femoris* is a slip of tendon about two inches long, which reaches outwards almost horizontally, and is fixed into the groove above the margin of the acetabulum. In front it joins the other tendinous piece of

* Its extent is greater than that given usually to the muscle. For the limit of the lower line see the description of the hip bone in Quain's Anatomy, vol. i. p. 138 (Edition of 1856).

the rectus, which is attached to the anterior inferior iliac spine; and below it is connected by fibres with the capsule of the hip joint.

Origin of
pyriformis
in the
pelvis.

Insertion
into the
femur;

lies in sacro-
sciatic
notch;

Position to
other parts.

Dissect
out the
chief ves-
sels and
nerves,

and mus-
cular
branches.

The vessels
come from
the iliac.

Sciatic
artery;

course

and ending.

Branches to
joint and
muscles.

Coccygeal
branch.

The *PYRIFORMIS* arises in the pelvis from the front of the sacrum (p. 658), and comes from that cavity through the great sacro-sciatic notch. Outside the pelvis it ends in a tendon, and is inserted into the upper border of the great trochanter, in front of the gluteus medius, where it is commonly united with the tendon of the obturator internus.

As the muscle passes through the sacro-sciatic notch it divides that space into two parts: the upper of these gives passage to the gluteal vessels and nerve; and the lower transmits the sciatic and pudic vessels and nerves. Its upper border is contiguous to the gluteus medius, and its lower edge to the gemellus superior. Like the other rotator muscles in this situation, it is covered by the gluteus maximus, and rests on the hip joint.

Dissection.—The pyriformis may be cut across and raised towards the sacrum, to allow the dissector to follow upwards the sciatic and pudic vessels, and to trace the accompanying nerves to the lower part of the sacral plexus.

Some small nerves to the obturator internus, the gemellus superior, and the hip joint, are to be sought at the lower part of the plexus. A branch to the inferior gemellus and the quadratus will be found by raising the trunk of the great sciatic nerve; but it will be followed to its termination after the muscles it supplies have been seen.

SCIATIC AND PUDIC VESSELS.—The vessels on the back of the pelvis, below the pyriformis muscle, are also branches of the internal iliac (p. 620).

The *sciatic artery* supplies the buttock. After escaping from the pelvis below the pyriformis, it descends over the gemelli and obturator muscles, in the interval between the tuber ischii and the trochanter, as far as the quadratus femoris; here the artery ends in branches for the supply of the surrounding parts, and anastomoses with the internal circumflex branch of the profunda artery. In this course it furnishes *muscular* offsets to the great gluteus and the rotator muscles, and some *articular* branches to the hip joint; some cutaneous offsets bend round the margin of the gluteus. It supplies also the following named branches:—

a. The *coccygeal branch*, arising close to the pelvis, perforates the great sacro-sciatic ligament and the gluteus maximus, and ramifies in this muscle, and on the back of the sacrum.

b. The *branch to the great sciatic nerve* (comes nervi ischiadici) is very slender, and enters the substance of the nerve near the pelvis; it extends in the nerve along the thigh, supplying offsets to it.

Branch to the sciatic nerve.

c. The *branch to the quadratus* passes with the nerve of the same name beneath the gemelli and obturator internus, and gives branches to the hip joint and the inferior gemellus before it terminates in its muscle.

Branch to the quadratus.

The *pudic artery* belongs to the perinæum and the genital organs: it is smaller than the sciatic, and internal to it. Only a small part of the vessel, which winds over the ischial spine, is seen on the back of the pelvis, for it enters the perineal space through the small sacro-sciatic notch, and is there distributed (p. 469). It supplies a small branch over the back of the sacrum, which anastomoses with the gluteal and sciatic vessels; and a twig from it accompanies the nerve to the obturator internus muscle.

Pudic artery crosses the ischial spine.

The *veins* with the sciatic and pudic arteries receive contributing twigs corresponding with the branches of the arteries; and they open into the internal iliac vein.

Veins.

SCIATIC AND PUDIC NERVES.—The nerves appearing at the back of the pelvis below the pyriformis are branches of the sacral plexus to the lower limb (p. 627); they are furnished mostly to parts beyond the gluteal region, but a few small branches are distributed to muscles of the pelvis.

Nerves come from sacral plexus.

The *small sciatic* may be considered a cutaneous nerve of the back of the thigh, for it supplies only one muscle—the gluteus maximus: it springs from the lower part of the sacral plexus, and generally by two parts that remain separate. The nerve takes the course of the sciatic artery as far as the lower border of the great gluteus, where it gives many cutaneous branches upwards and downwards: much diminished in size at that spot, the nerve is continued along the back of the thigh, beneath the fascia, and ends below the knee in the integuments of the back of the leg. The branches which are distributed on or near the buttock are muscular and cutaneous.

Small sciatic nerve is chiefly a cutaneous nerve;

ends in the leg;

The *muscular branches* (inferior gluteal) enter the under surface of the gluteus maximus near the lower border. A separate offset of the sacral plexus is usually furnished to the upper part of the muscle.

gives branches to gluteus.

The *cutaneous branches* are directed upwards and downwards at the border of the gluteus.

Cutaneous

a. The *ascending set* are distributed in the superficial fascia over the lower part of the muscle.

ascending;

descending; *b.* The *descending* set supply the integument of the inner side of the thigh at the posterior aspect. One of these branches, which is larger than the others, is distributed to the genital organs, and is named *inferior pudendal* (p. 463); as it courses to the perinæum, it turns below the ischial tuberosity, and perforates the fascia lata at the inner part of the thigh to end in the perineal space. Sometimes the inferior pudendal is a distinct branch of the plexus.

inferior
pudendal
branch.
Great sci-
atic nerve;
outline of,

The *great sciatic* is the largest nerve in the body. It is the source of all the muscular, and of most of the cutaneous branches distributed to the limb beyond the knee, as well as of the muscular branches at the back of the thigh.

and ending.

At its origin it appears to be a prolongation of the interlacement of the nerves of the sacral plexus. After leaving the pelvis it is directed through the buttock to the posterior part of the thigh, where it divides into two branches for the leg. In the part of its course now dissected, viz., to the lower border of the gluteus maximus, it lies in the hollow between the tuber ischii and the great trochanter, and rests on the external rotator muscles below the pyriformis. Commonly it does not supply any branch to the buttock, but it may give origin to one or two filaments to the hip joint.

Course in
the but-
tock.

No branch
in this
part.

Frequently the nerve is divided into two large trunks at its origin, and one of them pierces the fibres of the pyriformis muscle.

Pudic
nerve.

The *pudic nerve* winds over the ischial spine of the hip bone with its companion artery, and is distributed with it to the perinæum and the genital organs (p. 470). No branch is supplied to the buttock.

Nerve to
obturator.

The *nerve to the obturator internus* arises from the upper part of the plexus, and is directed to its muscle through the small sacro-sciatic notch with the pudic nerve: its termination is seen in the dissection of the pelvis (p. 658).

Other
branches of
the plexus.
Nerves to
the hip;

The remaining muscular and articular branches are derived from the lower part of the sacral plexus.

to superior
gemellus.

Some *nerves to the hip joint* perforate the back of the capsular ligament.

Nerve to
gemellus
and quadra-
tus.

The *nerve to the superior gemellus* is a very small twig, and arises separately from the following:

The *nerve to the inferior gemellus* and the *quadratus* is a slender branch. It passes with a companion artery beneath the gemelli and the obturator internus, and ends in the two muscles from which it receives its designation. This nerve will be seen more fully in a subsequent dissection, when *articular* filaments from it to the hip joint may be recognised.

Dissection.—To see the remaining small rotator muscles, hook aside the great sciatic nerve, and take away the branches of the sciatic artery if it is necessary. In cleaning these muscles the limb should be rotated inwards. The gemelli are to be turned aside from the tendon of the obturator internus.

Clean rotator muscles.

The SUPERIOR GEMELLUS is the highest of the two muscular slips along the sides of the tendon of the obturator muscle. Internally it is attached to the outer and lower part of the ischial spine, and externally it is inserted with the obturator into the great trochanter. Oftentimes this muscle is absent.

Superior gemellus.

The INFERIOR GEMELLUS is larger and more constant than its fellow. Its *origin* is connected with the upper and hinder part of the ischial tuberosity along the lower edge or lip of the hollow for the obturator internus muscle, and its *insertion* is the same as that of the obturator tendon. This muscle is placed between the obturator internus and quadratus muscles, but near the femur the tendon of the obturator externus comes into contact with its lower border.

Inferior gemellus

inserted with obturator.

The OBTURATOR INTERNUS arises inside the pelvis (p. 658), and passes to the exterior through the small sacro-sciatic notch. Escaped from the pelvis, the muscle is directed outwards over the articulation of the hip, and is *inserted* by a tendon with the gemelli into the upper part of the great trochanter, in front of the pyriformis, as well as into the contiguous portion of the neck of the femur.

Obturator internus has part inside

and part outside pelvis;

Outside the pelvis the obturator is mostly tendinous, and is embraced by the gemelli muscles; beneath it is a synovial sac. Crossing the muscle are the large and small sciatic nerves, and the sciatic vessels; and covering the whole is the gluteus maximus. On cutting through the tendon and raising the inner end, it will be found divided into four or five pieces as it turns over the margin of the pelvis; at this spot the pelvis is marked by ridges of fibro-cartilage, that correspond with the intervals between the tendons, and the whole is lubricated by a synovial membrane.

latter part lies over hip joint.

Its tendon is divided on the edge of the pelvis.

The QUADRATUS FEMORIS has the form expressed by its name, and is situate between the inferior gemellus and the adductor magnus. Internally it *arises* from the outer border of the tuber ischii, along the side of the origin of the semi-membranosus and adductor magnus; externally it is *inserted* into the linea quadrati of the upper end of the femur, above the attachment of the great adductor to the same line.

Quadratus femoris;

origin; insertion;

By one surface it is in contact with the sciatic vessels and parts above

- and beneath it, nerves, and the gluteus. By the other surface it rests on the obturator externus, the internal circumflex artery, and the small branches of both the nerve and artery supplying it.
- and at lower border. Between its lower border and the adductor magnus one of the terminal branches of the internal circumflex artery issues. Between it and the small trochanter is a bursa, which is common also to the upper part of the adductor magnus.
- Dissect circumflex artery. *Dissection.*—The quadratus and the gemelli muscles may be now cut across, in order that their small nerve and artery, the obturator externus, and the ending of the internal circumflex artery, may be dissected out.
- Internal circumflex artery. The *internal circumflex* branch of the profunda artery (p. 700) divides finally into two parts. One ascends beneath the quadratus, in this position of the body, to the pit of the trochanter, where it anastomoses with the gluteal artery, and supplies the bone. The other passes between the quadratus and adductor magnus to the hamstring muscles, and communicates likewise with the sciatic artery.
- ends in two branches. The OBTURATOR EXTERNUS has been dissected at its origin in the front of the thigh (p. 703). In the part of its course now laid bare, the muscle winds backwards below the hip joint, and ascends to be inserted into the pit at the root of the great trochanter. On the back of the pelvis the obturator externus is covered by the quadratus, except near the femur, where the upper border is in contact with the inferior gemellus.
- Obturator externus. The SACRO-SCIATIC LIGAMENTS pass from the innominate bone to the sacrum and the coccyx ; they are two in number, and are named large and small.
- is inserted into pit of trochanter. The *large* or *posterior* ligament is attached internally to the posterior lower iliac spine, and to the side of the sacrum and coccyx ; and externally it is inserted into an impression on the inner and anterior part of the ischial tuberosity. It is wide next the sacrum, but is contracted towards the middle, and is expanded again at the tuberosity ; from its outer attachment it sends upwards a prolongation along the pubic arch. On the cutaneous surface are the branches of the sacral nerves ; and the gluteus maximus conceals and takes origin from it.
- Connections. The *small ligament* will be seen on dividing the other near the hip bone. At the sacrum and coccyx it is united with the large ligamentous band, but at the opposite end it is inserted into the ischial spine. It is less strong than the superficial ligament, by which it is concealed ; and it rests on the coccygeus muscle.
- Sacro-sciatic ligaments.
- Attachments of the large one.
- Form ;
- gives a prolongation.
- Small ligament attachments.

By their attachments to the bones these ligaments convert the large sacro-sciatic notch of the dried pelvis into two apertures or foramina. Between their insertion into the spine and tuberosity of the innominate bone, is the small sacro-sciatic foramen, which contains the internal obturator muscle with its nerve, and the pudic vessels and nerve. And above the smaller ligament is the large sacro-sciatic foramen, which gives passage to the pyriformis muscle, and several vessels and nerves; viz., the gluteal vessels, and the superior gluteal nerve above the muscle, and the sciatic and pudic vessels and nerves with some muscular branches of the sacral plexus below the muscle.

They give rise to two notches:

small, with contents;

large, and parts passing through it.

SECTION III.

THE BACK OF THE THIGH.

Directions.—The ham or the popliteal space may be taken after the buttock, in order that it may be seen with its size and boundaries less disturbed than if it was dissected subsequently to the examination of the muscles at the back of the thigh. When this space has been learnt the student will return to the dissection of the thigh.

Directions.

Position.—The limb is to remain in the same position as in the dissection of the buttock.

Position.

Dissection.—To remove the skin from the popliteal region, let an incision be made behind the knee joint, beginning it about six inches above the knee, and ending it four inches below the joint. At each extremity of the longitudinal cut let a transverse incision be made, so as to allow the skin to be raised in two flaps; of these one is to be turned outwards, and the other inwards.

Take the skin from over the ham.

In the superficial fascia some small cutaneous nerves may be found, viz., one or two twigs in the middle line of the limb from the small sciatic nerve beneath the fascia; and some offsets of the internal cutaneous towards the inner part. After the fat is removed, the special fascia of the limb will be brought into view.

Seek the cutaneous nerves.

Fascia lata.—Where the fascia covers the popliteal space it is strengthened by transverse fibres, particularly on the outer side; and at each side it is connected with the tendons bounding that interval. The short saphenous vein perforates

Fascia of the limb over the ham.

it sometimes opposite the knee, but usually at a spot lower down.

Remove
fascia,

and take
the fat from
the ham.

Seek the
nerves in
the space.

Clean the
vessels ;

find obtu-
rator nerve.

The ham ;
situation
and extent.

Bounda-
ries ;

outer

and inner.

Dissection.—The fascia over the ham is now to be removed without injuring the small sciatic nerve and the short saphenous vein, which are beneath it. A large quantity of fat may be next taken out of the space, and several vessels and nerves are to be looked for in it. After the ham has been cleaned, the sartorius and the gracilis are to be replaced in their natural position on the inner side.

In the middle line the student will come upon the large internal popliteal nerve ; and nearer the outer side, on the external popliteal. Both nerves give branches ; and their offsets will be recognised more certainly by tracing them from above down along the trunk of the nerve, than by proceeding in the opposite direction. In fat bodies the small nerves to the knee joint are difficult to find. Under cover of the outer boundary, and deep in the space, is an articular nerve from the external popliteal, which sometimes arises from the great sciatic.

In the bottom of the space are the popliteal vessels, and the vein is more superficial than the artery. The student is to seek an articular branch (superior), on each side, close above the condyle of the femur. Numerous other branches of the vessels to the muscles around, especially below, are to be cleaned. On the upper part of the artery, the branch of nerve from the obturator to the knee joint may be found.

The **POPLITEAL SPACE**, or the ham, is the hollow behind the knee. It allows of the free flexion of the joint ; and in it the large vessels of the limb are contained. When dissected, this interval has the form of a lozenge, and extends upwards along one third of the femur, and downwards along one sixth of the tibia ; but in the natural condition of the parts the sides are approximated by the fascia of the limb, and the space is limited, apparently, almost to the region of the joint.

This hollow (fig. 104) is situate between the attachments to the femur of muscles on the back of the limb, and the lateral boundaries are therefore formed in part by the muscles of the thigh (hamstrings), and in part by those of the leg. Thus, on the outer side, is the biceps muscle ⁽⁶⁾ as far as the joint ; and the plantaris and the external head of the gastrocnemius ⁽⁸⁾ are beyond that spot. On the inner side, as low as the articulation, are the semimembranosus ⁽⁴⁾ and semitendinosus ⁽⁵⁾ muscles, with the gracilis and sartorius

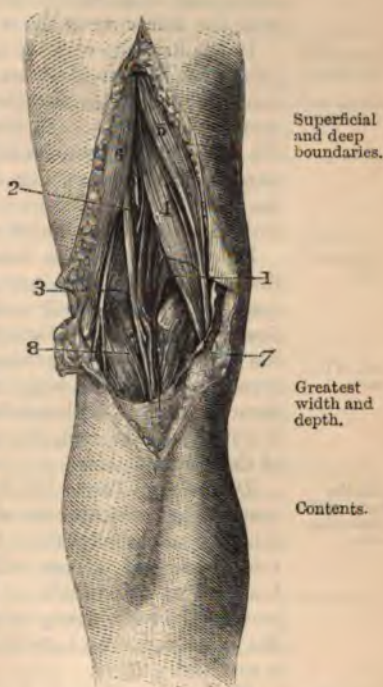
between them and the femur ; and beyond the joint is the inner head of the gastrocnemius (⁷). The upper point of the ham is limited by the apposition of the inner and outer hamstrings in the middle line of the thigh ; and at the lower point the heads of the gastrocnemius touch each other.

Stretched across the cavity is the fascia lata. Forming the deep boundary, or the floor, are the following parts, —the lower end of the posterior surface of the femur included between the lines to the condyles, the posterior ligament of the knee joint, and the popliteus muscle with the upper end of the tibia.

The popliteal space is widest opposite the knee joint, where the muscles are most drawn to the sides, and is deepest above the articular end of the femur. In it are contained the popliteal vessels and their branches, and the ending of the external saphenous vein ; the popliteal divisions of the great sciatic nerve, and some of their branches ; together with lymphatic glands, and a large quantity of fat. The small sciatic nerve lies over the space ; and a branch of the obturator is on the artery in the bottom of the hollow.

The POPLITEAL ARTERY (fig. 104, ¹) is the continuation of the femoral trunk. It reaches from the opening in the adductor magnus to the lower border of the popliteus muscle ; and at this spot it terminates by bifurcating into

Fig. 104.*



Limit
above and
below.

Superficial
and deep
boundaries.

Greatest
width and
depth.

Contents.

Popliteal
artery ;
extent ;

* View of the popliteal space (from Quain's Arteries). 1. Popliteal vessels. 2. Internal popliteal nerve. 3. External popliteal nerve. 4. Semimembranosus muscle. 5. Semitendinosus muscle. 6. Biceps muscle. 7, 8. Inner and outer heads of the gastrocnemius muscle. The superficial vein on the gastrocnemius is the short saphenous, which enters the popliteal.

part is in the ham, and part beyond. the anterior and posterior tibial vessels. A portion of the vessel lies in the ham, and is uncovered by muscle; but the rest is beneath the gastrocnemius, and beyond the limits of the popliteal space as above defined. The description of the artery may be divided therefore into two parts, corresponding with the difference in the connections.

The part in the space; course and connections. In the ham the vessel is inclined obliquely from the inner side of the limb to the interval between the condyles of the femur, and it is then directed along the middle of the space over the knee joint. In this course it is overlaid at first by the belly of the semimembranosus muscle, but thence onwards to the gastrocnemius it is covered only by the fat, the fascia lata, and the integuments. Beneath it is the femur with the posterior ligament of the knee joint.

Position of vein and of the nerve. In contact with the vessel and somewhat on the outer side, lies the popliteal vein, so that, on looking into the space, the arterial trunk is almost covered by it; but lower down, in the interval between the heads of the gastrocnemius, the vein and its branches altogether conceal the artery. More superficial than the large vessels, and slightly external to them in position, is placed the internal popliteal nerve, which however, like the vein, lies over the artery between the heads of the gastrocnemius.

Cut the head of the gastrocnemius. *Dissection.*—To see the deep part of the artery the inner head of the gastrocnemius should be cut through, and raised from the subjacent parts. On removing the areolar tissue the vessels and nerves will appear. The lower articular branches of the vessels and nerves are now brought into view;—the inner artery is below the head of the tibia, and the outer higher up between the tibia and fibula, each with a vein and a nerve.

Connections of the artery farther on. Whilst the artery is beneath the gastrocnemius it sinks deeply into the limb, and is crossed by a small muscle, the plantaris. It is placed on the popliteus muscle. Both the vein and the nerve (internal popliteal) change their position to the artery, and gradually cross over it, so as to lie on its inner side at the lower border of the popliteus.

Branches. Branches are furnished by the artery to the surrounding muscles, and to the articulation; those that enter the joint are five in number, and are called articular, viz., two superior, inner and outer; two inferior, also inner and outer; and a central or azygos branch.

Muscular branches and cutaneous. The muscular branches have not received separate names, with the exception of those to the gastrocnemius and soleus which are called *sural*. One *superficial* or cutaneous branch

accompanies the external saphenous nerve over the muscles of the leg.

The *superior articular* arteries arise from the popliteal trunk, one from the inner and one from the outer side, above the condyles of the femur; they are directed almost transversely beneath the hamstring muscles, and turn round the bone to the front of the joint. Branches to the joint are five.

a. The *external* one perforates the intermuscular septum, and divides in the substance of the vastus externus. Some of the branches end in that muscle, and anastomose with the external circumflex (of the profunda); others descend to the joint; and one offset forms an arch across the bone with the anastomotic artery. Two superior,

b. The *internal* artery, oftentimes very small, winds beneath the tendon of the adductor magnus, and terminates in branches in the vastus internus, which supply it and the knee joint, and communicate with the anastomotic artery. external.

The *inferior articular* branches lie beneath the gastrocnemius, but are not on the same level on opposite sides of the limb, for the inner one descends below the head of the tibia, whilst the outer one is placed above the fibula. Each lies beneath the lateral ligament of its own side. Two inferior; .

a. The *external* branch supplies the outer side of the knee joint, anastomosing with the other vessels on the articulation, and with the recurrent branch of the anterior tibial artery; it sends an offset beneath the ligament of the patella to join a twig from the lower internal branch. external;

b. The *internal* artery ascends at the anterior border of the internal lateral ligament, and after taking its share in the free anastomoses over the joint, ends in offsets for the articulation and the head of the tibia. internal;

The *azygos* branch enters the back of the joint through the posterior ligament, and is distributed to the ligamentous structures and fat and the synovial membrane of the interior. and one central artery.

The **POPLITEAL VEIN** originates in the union of the venæ comites of the anterior and posterior tibial vessels, and has the same extent and connections as the artery it accompanies. At the lower border of the popliteus muscle the vein is internal to the arterial trunk. Between the heads of the gastrocnemius it is superficial to that vessel. And thence to the opening in the adductor magnus it lies to the outer side, and close to the artery. It is joined by branches corresponding with those of the artery, as well as by the short saphenous vein (fig. 104). Popliteal vein.
Position to the artery.
Branches.

Popliteal artery may divide soon. *Peculiarities in the division of the artery.*—The chief peculiarity of the popliteal artery consists in its early division into terminal branches. In some bodies the artery will be found divided as high as the back of the knee joint; and in such instances the anterior tibial artery may lie beneath the popliteus muscle.

Vein may leave the artery *Course and position of the vein.*—Occasionally the vein will be placed on the inner instead of the outer side of the artery. And the popliteal vein may pass through the adductor magnus at a spot higher than the common opening, and enter the profunda vein.

or be split. *Double vein.*—There may be a venous trunk on each side of the artery for a certain distance, in consequence of the venæ comites of the tibial arteries not blending together as soon as is usually the case.

Popliteal nerves are two, **inner and outer.** The **POPLITEAL NERVES** are the two large trunks derived from the division of the great sciatic in the thigh; they are named internal and external from their relative position. In the popliteal space each furnishes cutaneous and articular offsets, but only the inner one supplies branches to muscles.

The internal nerve in the space. The **INTERNAL POPLITEAL NERVE** (fig. 104, ²) is larger than the external, and occupies the middle of the ham. Its connections are the same as those of the artery, that is to say, it is partly superficial and partly covered by the gastrocnemius. Like the vessel it extends through the back of the leg, and retains the name popliteal only to the lower border of the popliteus muscle. Its position with reference to the vessels has been already noticed. The branches that arise from it here are the following:—

Branches are two or three articular; Two or three small *articular* twigs are furnished to the knee joint with the vessels. One with the lower internal articular artery is of considerable size; and another takes the same course as the azygos artery. Occasionally a third may be found with the upper internal articular artery.

muscular; *Muscular* branches arise from the nerve between the heads of the gastrocnemius. One supplies both heads of the gastrocnemius and the plantaris. Another descends beneath the gastrocnemius and enters the cutaneous surface of the soleus. And a third penetrates the popliteus at the under aspect, after turning round the lower border.

external saphenous nerve. The *external saphenous* nerve (ram. communicans tibialis) is the largest branch, and is a cutaneous offset to the leg and foot. It lies on the surface of the gastrocnemius, but beneath the fascia as far as the middle of the leg, where it becomes cutaneous, and will be afterwards seen (p. 727).

External popliteal nerve. The **EXTERNAL POPLITEAL NERVE** (peroneal) lies along the outer boundary of the ham (fig. 104, ³) and follows the biceps muscle to the head of the fibula. Below the head of

that bone the nerve enters the fibres of the peroneus longus muscle, and divides beneath it into two,—musculo-cutaneous and anterior tibial. Its branches whilst in the popliteal space are cutaneous and articular. Branches;

The *articular* nerve runs with the upper external artery to the outer side of the knee, where it sends a twig along the lower articular artery: both enter the joint. articular.

The *peroneal communicating* branch (ram. communicans fibularis) is a cutaneous nerve, and joins the external saphenous branch of the internal popliteal about the middle of the leg (fig. 105, ^b). It arises near the head of the fibula, and soon pierces the deep fascia. Cutaneous offsets are given by it to the back of the leg. Communi-
cating
branch.

One or two other *cutaneous* offsets are furnished by the external popliteal to the integument on the outer part of the leg in the upper half. Cutaneous
offsets.

The *articular branch* of the *obturator nerve* perforates the adductor magnus, and is conducted by the popliteal artery to the back of the knee joint. After supplying filaments to the vessel, the nerve enters the articulation through the posterior ligament. Articular
nerve of the
obturator.

The *lymphatic glands* of the popliteal space are situated around the large arterial trunk. Two or three are ranged on the sides; whilst one is superficial to, and another beneath the vessel: they are joined by the deep lymphatic vessels of the lower limb, as well as by the superficial set accompanying the saphenous vein. Lymphatic
glands
around the
artery.

Dissection.—Now the anatomy of the popliteal space has been learnt, the student may proceed with the dissection of the back of the thigh. The piece of skin therefore between the buttock and the popliteal space should be divided and reflected to the sides. Dissect the
back of the
thigh.

In the fat on the sides of the limb offsets of the internal and external cutaneous nerves of the front of the thigh may be found, if they have been preserved in front; and along the middle line some filaments from the small sciatic nerve pierce the fascia. Seek out
cutaneous
nerves.

Lastly, remove the deep fascia of the limb, taking care of the small sciatic nerve; and then clean the hamstring muscles, and trace into them the perforating arteries and the branches of the great sciatic nerve. Clean mus-
cles and
nerves.

The **MUSCLES ON THE BACK OF THE THIGH** act as flexors of the knee joint. They extend from the pelvis to the bones of the leg, and are named hamstrings from their cord-like appearance on the sides of the ham: they are three in Three mus-
cles on back
of thigh.

Situation. number, viz., biceps, semitendinosus, and semimembranosus. The first of these lies on the outer, and the others on the inner side of the popliteal space.

Biceps arises by a long and a short head ; The BICEPS has two heads of *origin*, long and short, which are attached to the pelvis and the femur. The long head arises from an impression on the back of the ischial tuberosity, in common with the semitendinosus muscle. The short head is fixed to the femur below the gluteus maximus, viz., to all the linea aspera, and nearly the whole of the line leading inferiorly to the outer condyle ; and to the external intermuscular septum. The fibres from these sources are collected together to form the belly of the muscle ; and end inferiorly in a tendon, which is *inserted* into the head of the fibula by two processes that embrace the external lateral ligament, and slightly into the head of the tibia.

is inserted into the fibula and tibia.

Connections of the muscle.

The muscle is superficial, except at the origin where it is covered by the gluteus ; and it rests on the upper part of the semimembranosus, on the great sciatic nerve, and on the adductor magnus muscle. On the inner side is the semitendinosus muscle as far as the ham. Its tendon gives offsets to the deep fascia of the limb.

Semitendinosus is attached to pelvis and tibia.

The SEMITENDINOSUS is a slender muscle, and receives its name from its appearance. It *arises* from the tuberosity of the hip bone with the long head of the biceps, and by fleshy fibres from the tendon of that muscle. Inferiorly it is *inserted* into the inner surface of the tibia, close below the gracilis, and for a similar distance.

Surrounding parts in contact with it.

This muscle, like the biceps, is partly covered by the gluteus maximus. About its middle a tendinous intersection may be observed. It rests on the semimembranosus, and on the internal lateral ligament of the knee joint. The outer border is in contact with the biceps as far as the popliteal space. As the tendon turns forwards to its insertion, an expansion is continued from it to the fascia of the leg ; and it is attached with the gracilis below the level of the tubercle of the tibia, the two being separated from the tendon of the sartorius by the bursa before referred to (p. 688).

Semimembranosus reaches from pelvis to tibia.

The SEMIMEMBRANOSUS muscle is tendinous at both ends, and its name is taken from the membraniform appearance of the upper tendon. The muscle is attached above to the highest impression on the back of the tuber ischii, above and external to that for the semitendinosus and biceps ; and it is *inserted* below into the hinder and inner part of the head of the tibia.

The muscle presents a thick fleshy belly inferiorly, where it bounds the popliteal space. On it is the semitendinosus, which is lodged in a hollow in the upper tendon; and beneath it is the adductor magnus. Along the outer border is the great sciatic nerve; and below the place of division of that nerve, is the internal popliteal trunk. Between its tendon and the inner head of the gastrocnemius is a large bursa. The insertion of the muscle will be dissected with the tendons in connection with the knee joint.

Parts
around it.

The GREAT SCIATIC NERVE lies on the adductor magnus between the buttock and the popliteal space, and divides into the two popliteal nerves about the middle of the thigh, though its point of bifurcation may be carried upwards as far as the pelvis. In this extent the nerve lies along the outer border of the semimembranosus, and is crossed by the long head of the biceps.

Great
sciatic nerve
in the
thigh

Branches.—At the upper part of the thigh it supplies branches to the flexor muscles and the adductor magnus.

supplies
flexor and
adductor
muscles.

SMALL SCIATIC NERVE.—Between the gluteus maximus and the ham this small nerve is close beneath the fascia, but it becomes cutaneous below the knee, and accompanies the external saphenous vein for a short distance.

Small
sciatic in
the thigh;

Small *cutaneous* filaments pierce the fascia of the thigh, and the largest of these is near the popliteal space.

cutaneous
offsets.

Dissection.—To see the posterior surface of the adductor magnus, and the branches of the perforating arteries, the hamstring muscles must be detached from the hip bone and thrown down, and the branches of arteries and nerves they receive may be cut through if it is necessary. The parts referred to are to be cleaned.

Detach the
ham-
strings.

ADDUCTOR MAGNUS MUSCLE.—At its posterior aspect the large adductor is altogether fleshy, even to the opening for the femoral artery; and the fibres from the pubic arch appear to form a part almost distinct from those connected with the tuberosity of the hip bone. In contact with this surface are the hamstring muscles and the great sciatic nerve.

Posterior
surface of
adductor
magnus.

Ending of the perforating arteries.—These arteries are four in number, and the spots at which they pierce the adductor muscles have been referred to before (p. 701).

Number of
arteries.

On the back of the thigh all of them supply offsets to the flexor muscles of the knee, and end in the vastus externus. The lowest three are directed outwards to the vastus close to the bone, and usually through the short head of the biceps, though the second perforating artery may run higher up than the attachment of the head of the biceps.

Muscles
supplied
end in vas-
tus exter-
nus.

Hip joint,
how
formed ;

its liga-
ments.

Lay bare
the capsule.

Capsule.

Attach-
ments
above

and below.

On the front
is a band of
fibres.

Another
outside.

Muscles
around.

Cut open
the cap-
sule.

Cotyloid
ligament

attached
around
acetabulum.

THE HIP JOINT (fig. 100).—This articulation is a ball and socket joint, in which the head of the femur is received into the acetabulum or the cup-shaped cavity of the innominate bone. Connecting the bones are the following ligaments :—one to deepen the receiving cavity, which is named cotyloid ; another between the articular surfaces of the bones,—the interarticular ; and a loose capsule surrounds all.

Dissection.—The muscles are to be taken away from the back of the hip joint, and the upper and lower attachments of the capsular ligament must be defined. Afterwards the front of the joint should be dissected in the same manner, with the body turned over for a short time, if this change in the position does not interfere with the other dissections.

The *capsular ligament* (fig. 100, ¹¹) is a loose fibrous covering that is fixed by one end around the acetabulum, and by the other to the neck of the femur. Its upper margin is attached to the circumference of the acetabulum at a short distance from the edge, as well as to a transverse ligamentous band over the notch at the inner side of the cavity. Its lower margin is inserted in front into the anterior intertrochanteric line, and behind, by a very thin attachment, into the neck of the femur about a finger's breadth from the posterior intertrochanteric line and the trochanters.

The capsule is thinnest below, where it is in contact with the obturator externus. In front it is thickened by a band of fibres—*ilio-femoral ligament* (fig. 100, ¹²) crossing from the lower of the two anterior iliac spines to the trochanteric line ; and at the upper and outer part there is another strong band, which is attached externally to the top of the great trochanter in front, and is connected with the tendon of the gluteus minimus. Posteriorly the joint is covered by the external rotator muscles ; and anteriorly by the psoas and iliacus, a bursa being between it and them. Above is the gluteus medius, and below is the obturator externus.

Dissection.—The capsular ligament should be divided over the prominence of the head of the femur, and this bone being disarticulated the cotyloid and interarticular ligaments may be seen.

The *cotyloid ligament* is a band of fibro-cartilage, which is fixed to the margin of the acetabulum, and is prolonged across the notch on the inner side, so as to form part of the *transverse ligament*. It is thickest at its attachment to the bone, and becomes gradually thinner towards the free margin, where it is applied to the head of the femur. This

ligament deepens the socket for the femur in the same manner as the glenoid ligament increases the surface for the reception of the head of the humerus.

The *transverse ligament* is a firm but narrow band, which reaches across the notch at the inner side of the acetabulum. It consists partly of deep special fibres that are attached to the margins of the notch, and partly of a superficial bundle from the cotyloid ligament. Beneath it is an aperture by which vessels enter the acetabulum to nourish the synovial membrane, and the fat in the bottom of that hollow.

The *interarticular or round ligament* (ligam. teres) is a slight band connecting the femur with the innominate bone. One extremity is roundish, and is inserted into the pit in the head of the femur. The other is bifid, and is connected to the sides of the notch in the cotyloid cavity, the lowest lip of the notch receiving the strongest band.

A *synovial membrane* lines the capsular ligament, and is continued along it to the acetabulum and the head of the femur. In the bottom of the cotyloid cavity it is reflected over the fat in that situation; and it surrounds the ligamentum teres.

Dissection.—To see the surface of the acetabulum the lower limb is to be separated from the trunk by dividing the interarticular ligament, and by cutting through any parts that attach it to the rest of the body.

Surfaces of bone.—The articular surfaces of the bones are not completely covered with cartilage. In the head of the femur is a pit into which the round ligament is inserted. In the bottom of the acetabulum is a space free from cartilage, in which a reddish fatty mass is lodged: this is sometimes called the synovial gland. Beneath the transverse ligament an artery and a nerve enter the joint to supply the fat.

SECTION IV.

THE BACK OF THE LEG.

Directions.—Before the dissection of the leg is begun, the student should make himself acquainted, as in the thigh, with the prominences of bone and muscle on the surface, and with the markings that lead to the position of the larger vessels.

In the leg
the tibia
and fibula
are super-
ficial.

Prominences on the surface.—The bones of the leg can be traced beneath the skin from the knee to the ankle joint. On the inner side of the limb is the tibia, which is subcutaneous in all its extent, and is limited in front and behind by a sharp ridge. Above, it presents in front a prominent tubercle into which the ligament of the patella is inserted; and below, it ends on the inner side of the ankle in the internal malleolar projection. On the outer side of the leg the lower half of the fibula may be felt with ease, but the upper half with more difficulty in consequence of the prominence of the muscles of the calf. The head of this bone may be recognised below the knee; and the lower end forms the projection (malleolus) on the outer side of the ankle joint.

Behind is
calf of the
leg,
tendo
Achillis, and
tibial ves-
sels.

On the posterior aspect of the leg is the projection of the calf: this is formed by the superficial muscles, and from it descends the firm band of the tendo Achillis, by which those muscles are connected with the heel. Between the tendon and the edge of the tibia, but nearest the former, is the superficial part of the posterior tibial artery. In front between the tibia and fibula are the flexor muscles of the foot and the extensors of the toes, amongst which the anterior tibial artery lies deeply; the position of the vessel will be indicated by a line from the centre of the ankle joint to the inner side of the head of the fibula.

Line of
anterior
tibial ves-
sels.

Ankle joint.

On the sides of the ankle joint are the prominent malleoli; and when the joint is extended, the head of the astragalus projects below the border of the tibia.

Inner
border of
the foot.

At the inner border of the foot, about an inch in front of the internal malleolus, is the prominent scaphoid bone pointing out the spot at which an amputation (Chopart's) is practised; whilst farther forwards, by about one inch and a half, is a slight depression that marks the articulation between the internal cuneiform bone and the metatarsal bone of the great toe. About the centre of the outer border of the foot is the eminence of the tarsal end of the fifth metatarsal bone. A line over the dorsum of the foot, from the centre of the ankle joint to the interval between the inner two toes, will be over the position of the main artery.

Outer
border.

Dorsal
artery.

Position of
the part.

Position.—For the dissection of the back of the leg the limb is to be placed on its front, with the foot over the side of the dissecting-table, and the muscles of the calf are to be put on the stretch by fastening the foot.

Take away
the skin.

Dissection.—For the removal of the skin, one cut may be made along the middle of the leg to the sole of the foot, where a transverse incision is to be carried over the heel.

The two resulting flaps of skin may be raised; the outer one is to be detached as far as the fibula, and the other as far as the inner margin of the tibia.

In the fat the cutaneous nerves and vessels are to be followed. On the inner side, close to the tibia, is the internal saphenous vein with the nerve of the same name, together with twigs of the internal cutaneous near the knee. In the centre is the external saphenous vein, with the small sciatic nerve above the middle of the leg, and the external saphenous nerve below the middle. On the outer side are the cutaneous offsets of the external popliteal nerve.

Seek cutaneous nerves in the fat.

The *superficial fascia* or the fatty layer of the back of the leg is least thick over the tibia. Over the line of the superficial vessels it may be separated into two layers as in the thigh.

Superficial fascia.

SUPERFICIAL VEINS.—Two veins appear in the dissection of the back of the leg, which are named saphenous—inner and outer.

Two superficial veins.

The *internal saphenous vein* begins in an arch on the dorsum of the foot. Ascending along the leg in front of the inner ankle, and then behind the inner edge of the tibia, it reaches the thigh where it has been already noticed (p. 673). In the leg the vein is joined by superficial branches, and by deep roots from the tibial veins.

Internal saphenous.

The *external saphenous vein* begins at the outer end of the arch on the dorsum of the foot, and appears below the outer ankle. The vein then courses along the back of the leg to the ham, where it ends in the popliteal vein. It receives large branches about the heel, and others on the back of the leg.

External saphenous.

CUTANEOUS NERVES.—The nerves in the subcutaneous fat of the back of the leg are prolongations of branches already examined in part, viz. the internal and external saphenous, cutaneous offsets of the external popliteal, the small sciatic nerve, and offsets of the internal cutaneous of the thigh.

Cutaneous nerves.

The *internal saphenous nerve*, which has been traced before to the knee (p. 694), accompanies the vein of the same name in the leg (fig. 108, '1) and terminates at the middle of the inner border of the foot. In the leg the nerve gives off lateral cutaneous offsets, and the outer of these turn over the tibia to the anterior aspect.

Internal saphenous.

Termination.

The *external saphenous nerve* (fig. 105, '1) is a branch of the internal popliteal (p. 720). Perforating the deep fascia about the middle of the leg, it is continued with the external saphenous vein below the outer ankle, and is distributed to the outer side of the foot and little toe. As soon as the

External saphenous ends on the foot;

branches to the leg. nerve appears it is joined by the communicating branch of the external popliteal, and near the heel it gives large long branches to the integuments.

Branches of the popliteal; communicating *Cutaneous nerves of the external popliteal.*—One branch of the external popliteal trunk, viz. *communicating peroneal* (p. 721), joins the external saphenous nerve about the middle of the leg: but not uncommonly this branch extends as a distinct nerve, unconnected with the other, as far as the heel.† The other small *cutaneous* offsets of the external popliteal terminate over the outer side of the leg.

Fig. 105.*

and cutaneous.

Termination of small sciatic.

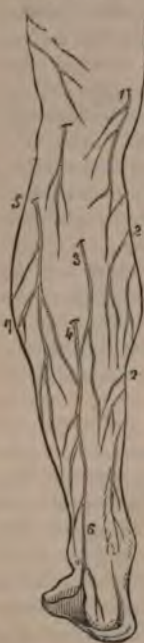
Termination of internal cutaneous.

Take away the fat.

Deep fascia.

Continuation

and attachments.



* Cutaneous nerves of the back of the leg.—1. Inner branch of the internal cutaneous. 2. Branches of the internal saphenous. 3. Small sciatic, giving higher up a branch through the fascia. 4. External saphenous. 5. Peroneal communicating branch of the external popliteal.

† Occasionally the junction may take place in or near the popliteal space.

it is fixed to the edge of the tibia. Veins are transmitted through it from the deep to the superficial vessels.

Dissection.—The fascia is to be divided along the centre of the leg as far as the heel, and is to be taken from the surface of the gastrocnemius muscle. By fixing with a stitch the inner cut head of the gastrocnemius, the cleaning the fibres of the muscle will be facilitated.

Take away the fascia.

SUPERFICIAL LAYER OF MUSCLES.—In the calf of the leg there are three muscles, gastrocnemius, soleus, and plantaris, which extend the ankle: the first two are large, and give rise to the prominence on the surface, but the last is inconsiderable in size and is chiefly tendinous.

Muscles in superficial layer.

The GASTROCNEMIUS is the most superficial muscle. United below in the common tendon, it has above two distinct pieces or heads, which connect it with the condyles of the femur. The inner head of *origin* is attached by a large tendon to an impression at the posterior aspect of the inner condyle, behind the insertion of the adductor magnus, and by fleshy fibres to the line above the condyle. The outer head is fixed by tendon chiefly to a pit on the outer surface of the corresponding condyle, above the attachment of the popliteus muscle, and also to the upper and back part of the same condyle. These pieces or heads are united along the middle line by a narrow thin aponeurosis, and terminate inferiorly with the soleus in the common tendon of insertion.

Gastrocnemius

arises by two heads from the femur,

ends below in tendo Achillis.

One surface is covered by the fascia. The other is in contact with the soleus and plantaris, and with the popliteal vessels and the internal popliteal nerve. The heads, by which the muscle arises, assist to form the lateral boundaries of the popliteal space: and the fleshy inner head descends lower than the outer. In the tendon attached to the outer condyle may be fibro-cartilage, or a sesamoid bone.

Parts covered by it.

Dissection.—To see the soleus, the gastrocnemius is to be reflected by cutting across the remaining head, as well as the vessels and nerves it receives. After the muscle has been thrown down, the soleus and the plantaris must be cleaned.

Detach gastrocnemius.

The SOLEUS is a large flat muscle, which is attached to both bones of the leg, and terminates, like the gastrocnemius, in the strong common tendon. It *arises* from the head, and the upper third or half of the posterior surface of the shaft of the fibula; from the oblique line across the tibia, and from the posterior edge of this bone in the middle third; and between the bones from an aponeurotic arch over the large bloodvessels. Its fibres are directed downwards to the lower tendon.

Soleus is attached to the bones of the leg,

and joins below the tendon.

- Parts over and under it. The superficial part of the soleus is in contact with the gastrocnemius ; and the opposed surfaces of the two are aponeurotic. Beneath the muscle are the bones of the leg, the deep layer of flexors, and the vessels and nerves.
- Tendo Achillis. TENDO ACHILLIS.—The *common tendon* of the gastrocnemius and soleus is one of the strongest in the body. It is wide above, and commences about the middle of the leg, though it receives fleshy fibres on the under surface nearly to the lower end : and below it is narrowed, and is *inserted* by a rounded bundle into the lower part of the os calcis at the posterior aspect. A bursa intervenes between it and the upper part of the calcaneum. The tendon is close beneath the fascia ; and lying along its outer side, but superficial to it, are the external saphenous vein and nerve.
- Extent and insertion.
- Plantaris. The PLANTARIS is remarkable in having a tendon the longest in the body, which takes the appearance of a riband when it is stretched laterally. The short fibres of the muscle *arise* from the line above the outer condyle of the femur, and from the posterior ligament of the knee joint ; and the tendon in which they end is *inserted* into the os calcis with or by the side of the tendo Achillis, or into the fascia of the leg.
- Position of the muscle. The belly of the muscle, about three inches in length, is concealed by the gastrocnemius, but the tendon appears on the inner side of the tendo Achillis about the middle of the leg. This little muscle crosses the popliteal vessels, and lies on the soleus.
- Detach soleus. *Dissection.*—The soleus is to be detached from the bones of the leg, and the vessels and nerves it receives are to be divided ; but in raising it the student should take care not to injure the thin deep fascia and the vessels and nerves. The superficial vessels may be next removed by cutting through their tendons near the os calcis.
- and clean the deep fascia. The piece of fascia between the muscles of the superficial and deep layers is to be then cleaned ; and the integuments between the inner ankle and the heel are to be taken away to lay bare the annular ligament, but a cutaneous nerve to the sole of the foot piercing the ligament is to be preserved.
- Deep part of the fascia of the leg. Lastly the student should open the bursa between the tendo Achillis and the os calcis, if this has not been done.
- Deep part of the fascia.*—This intermuscular layer of the fascia of the leg is fixed to the tibia and fibula, and binds down the deep layer of flexor muscles. Beneath the soleus it is thin and indistinct ; but lower in the limb it is much stronger, and is marked by some transverse fibres near the

malleoli, which give it the appearance and office of an annular ligament in that situation. Inferiorly it joins the annular ligament between the heel and the inner ankle.

Dissection.—The deep layer of muscles, the posterior tibial nerve, and the trunks and offsets of the posterior tibial and peroneal vessels, will be made ready for learning by the removal of the fascia and the areolar tissue. A muscle between the bones (tibialis posticus) is partly concealed by an aponeurosis which gives origin to muscles on the sides ; and it will not fully appear until after the membrane covering it has been divided.

Clean the deep muscles.

DEEP LAYER OF MUSCLES.—The deep flexor muscles at the back of the leg are four in number, viz. popliteus, flexor longus pollicis, flexor longus digitorum, and tibialis posticus. The first of these is close to the knee joint ; it crosses the bones, and is covered by a special aponeurosis. The flexors lie on the bones, the one of the great toe being on the fibula, and that of the other toes on the tibia. And the last muscle covers the interosseous membrane. With the exception of the popliteus, all enter the sole of the foot, and have a fleshy part parallel to the bones of the leg, and a tendinous part beneath the tarsus.

Four muscles in the deep layer.

Position and

destination.

The **POPLITEUS** arises within the capsule of the knee joint. It is attached by tendon to the fore and upper part of an oblong depression on the outer surface of the external condyle of the femur below the external lateral ligament ; and external to the capsule of the joint, some fleshy fibres arise from the posterior ligament. From the tendon the fibres radiate, and they are inserted into the tibia above the oblique line on the posterior surface.

Popliteus arises within knee joint.

Inserted into tibia.

The muscle lies on the tibia, and is covered by a fascia derived in great part from the tendon of the semimembranosus muscle. On it lie the popliteal vessels and the companion nerve, with the gastrocnemius and plantaris. Along the upper border are the lower articular vessels and nerve of the inner side of the knee. The lower border of the muscle corresponds with the attachment of the soleus on the tibia. The origin will be seen with the dissection of the ligaments of the knee joint.

Parts around it.

The **FLEXOR LONGUS POLLICIS** arises below the soleus from the lower half or two thirds of the posterior surface of the fibula except an inch inferiorly ; from the intermuscular septum between it and the peronei muscles ; and from the aponeurosis over the tibialis. Inferiorly the tendon of the muscle enters a groove in the astragalus, and afterwards

Flexor longus pollicis is attached to fibula.

- crosses the sole of the foot to reach its place of insertion into the great toe.
- Is partly superficial. In part the muscle is covered by the soleus ; but in part it is superficial, and is in contact with the fascia. It rests on the fibula and the lower end of the tibia, and conceals the peroneal vessels. Along the inner side are the posterior tibial nerve and vessels ; and contiguous to the outer margin, but separated by the fascia, are the peronei muscles.
- Muscles and vessels on sides. The *FLEXOR LONGUS DIGITORUM* (flexor perforans) is attached to the posterior surface of the tibia, extending from the popliteus to about three inches from the lower extremity, and it takes origin also from the aponeurosis covering the tibialis posticus. Its tendon enters a partition in the annular ligament, which is superficial in this position to the sheath of the tibialis ; and escaped from the ligament divides in the sole of the foot into tendons for the outer four toes.
- Flexor longus digitorum lies on tibia ; enters annular ligament. The muscle is narrow and pointed superiorly and is placed beneath the soleus ; but in the lower half it is in contact with the fascia, and the posterior tibial nerve and vessels lie on it. The deep surface rests on the tibia and the tibialis posticus.
- Part is superficial below soleus. The *TIBIALIS POSTICUS* occupies superiorly the interval between the bones of the leg, but it crosses over the tibia inferiorly to reach the inner side of the foot. The muscle arises from the aponeurosis separating it from the contiguous muscles, and from all the interosseous membrane except about one inch below ; from an impression along the outer border of the tibia, which reaches from the head of the bone to rather beyond the lower attachment of the flexor longus digitorum ; and from the adjacent inner surface of the fibula for the middle three fifths of its length. In the lower fourth of the leg this muscle is directed beneath the flexor digitorum ; and its tendon entering the inner space in the annular ligament, reaches the inner side of the foot to be inserted into the scaphoid and other bones (p. 747).
- Tibialis covers interosseous membrane. Origin : arises from the aponeurosis separating it from the contiguous muscles, and from all the interosseous membrane except about one inch below ; from an impression along the outer border of the tibia, which reaches from the head of the bone to rather beyond the lower attachment of the flexor longus digitorum ; and from the adjacent inner surface of the fibula for the middle three fifths of its length. In the lower fourth of the leg this muscle is directed beneath the flexor digitorum ; and its tendon entering the inner space in the annular ligament, reaches the inner side of the foot to be inserted into the scaphoid and other bones (p. 747).
- crosses beneath the flexor of the toes. Insertion. The tibialis is concealed by the aponeurosis before mentioned, and is overlapped by the neighbouring muscles ; but in the lower fourth of the leg it is placed between the tibia and the long flexor of the toes. On the muscle are the posterior tibial vessels and nerve. The upper part presents two pointed processes of attachment to the bones—that to the tibia being the highest—between which the anterior tibial vessels are directed forwards.
- Muscles and vessels in connection with it. The *aponeurosis* covering the tibialis is attached laterally to the bones, but has a defined border inferiorly over the
- The muscle covered by

muscle. By one surface it gives origin to the flexors of the toes, and by the other to the tibialis.

The POSTERIOR TIBIAL ARTERY is one of the branches resulting from the bifurcation of the popliteal trunk. The artery extends from the lower border of the popliteus muscle to the lower part of the internal annular ligament, where it ends in two plantar branches for the sole of the foot. At its origin the artery lies midway between the tibia and fibula, but as it approaches the lower part of the leg it gradually inclines inwards; and at its termination it is placed below the tibia, in the centre of the hollow between the heel and the inner ankle.

As far as the middle of the leg (in length) the vessel is concealed by two muscles of the calf, viz. gastrocnemius and soleus; but below that spot, as it lies between the tendo Achillis and the inner edge of the tibia, it is covered only by the integuments and the deep fascia. At its termination it is beneath the annular ligament. For the greatest part of its extent the arterial trunk lies over the tibialis posticus, but afterwards on the flexor digitorum, and on the lower end of the tibia and the ankle joint.

Venæ comites closely surround the vessel. The posterior tibial nerve is at first internal to the artery; but at the distance of one inch and a half it crosses to the outer side, and retains that position throughout.

This artery supplies branches to the muscles and the tibia, and a large peroneal trunk to the outer side of the leg.

1. *Muscular branches* enter the deep layer of muscles and the soleus; an offset from a branch to the latter muscle pierces the attachment to the tibia, and ascends to the knee joint.

2. A *nutritious* artery of the shaft of the tibia is uncertain in its place of origin: piercing the tibialis, it enters the canal on the posterior surface of the bone, and ramifies in the interior.

3. A *communicating* branch to the peroneal arises opposite the lower end of the tibia, and passes outwards beneath the flexor pollicis, to unite in an arch with a corresponding offset of the peroneal artery.

The PERONEAL ARTERY is often as large as the posterior tibial, and arises from that vessel about one inch and a half from the beginning. It takes the fibula as its guide, and lying close to the bone in the fibres of the flexor pollicis, reaches the lower part of the interosseous membrane. At this spot it sends forwards a branch to the front of the leg

an aponeurosis.

Posterior tibial artery. Extent.

Course.

Parts covering the upper and lower half.

Parts beneath it.

Veins. Nerve.

Branches.

Muscular.

Nutritious to tibia.

Communicating.

Peroneal artery

is contained in flexor pollicis.

Termination.	(anterior peroneal); and it is directed onwards over the articulation between the tibia and fibula to the outer side of the foot, where it terminates in branches, and anastomoses with the tarsal and external plantar arteries. Two companion veins surround the artery.
Branches.	<i>Branches.</i> —Besides the anterior peroneal, it furnishes muscular, nutritious, and communicating offsets.
Muscular.	1. <i>Muscular</i> branches are distributed to the soleus and the deep flexors, and some turn round the fibula to the peronei muscles.
Nutritious to fibula.	2. The <i>nutritious</i> artery is smaller than that to the tibia, and is transmitted through the tibialis posticus to the aperture about the middle of the fibula.
Anterior peroneal	3. The <i>anterior peroneal</i> branch passes forwards through an aperture in the lower part of the interosseous membrane, and is continued in front of the fibula to the dorsum and the outer part of the foot: on the front of the leg and foot it anastomoses with the external malleolar and tarsal branches of the anterior tibial artery.
to front of foot.	4. A <i>communicating</i> offset near the ankle joint joins in an arch, as before mentioned, with a similar branch of the posterior tibial. Sometimes there is a second arch between the same vessels.
Communicating.	
Size of tibial changes.	<i>Peculiarities in the arteries.</i> —The <i>posterior tibial artery</i> may be smaller than usual, or absent. Its place will be then supplied in the foot by a large peroneal artery, which is directed inwards at the lower end of the tibia, and either joins the small tibial vessel, or runs alone to the sole of the foot.
Origin and ending vary.	The <i>peroneal artery</i> may arise from the popliteal, or from the anterior tibial artery. And its anterior peroneal branch may take the place of the anterior tibial artery on the dorsum of the foot.
Substitutions.	A compensating principle may be observed amongst the arteries of the foot as in those of the hand, by means of which the deficiency in one is supplied by an enlarged offset of another.
Posterior tibial veins.	The POSTERIOR TIBIAL VEINS begin on the inner side of the foot by the union of the plantar veins: they ascend, one on each side of the artery, and unite with the anterior tibial trunks at the lower border of the popliteus, to form the large popliteal vein. They receive the peroneal veins, and branches corresponding with the offsets of the artery: branches connect them also with the saphenous veins.
Posterior tibial nerve.	The POSTERIOR TIBIAL NERVE is a continuation of the internal popliteal, and reaches, like the artery, from the lower border of the popliteus muscle to the interval between the os calcis and the inner malleolus. Whilst beneath the

annular ligament, or somewhat higher than it, the nerve divides into the internal and external plantar branches of the foot. Its connections with surrounding parts are the same as those of the artery; but its position to the vessel changes, for it lies on the inner side of the posterior tibial artery above the origin of the peroneal offset, but on the outer side thence to the termination. Its lateral branches are chiefly muscular.

Muscular branches enter the deep flexors, and arise either at separate points along the trunk, or together from the internal popliteal nerve. There is an offset for each muscle, except the popliteus; but the branch for the tibialis is the largest, and that for the flexor pollicis lies on the peroneal artery.

A *cutaneous nerve* of the sole of the foot pierces the internal annular ligament, and ends in the integuments of the inner and under part of the heel; this nerve will be followed to its termination in the dissection of the foot.

The *internal annular ligament* is placed between the heel and the inner ankle, and serves to confine the tendons of the deep flexor muscles of the foot and toes. Attached by a pointed part to the internal malleolus, the fibres diverge and are inserted into the os calcis. One border (upper) is continuous with the fascia of the leg; and the opposite gives attachment to the abductor pollicis muscle of the foot. Beneath it are sheaths for the tendons, which are formed by the fascia stretched over the subjacent osseous grooves. When the sheaths are opened, the innermost will be found to contain the tibialis posticus, which is lodged in a groove in the malleolus. Immediately behind this is another space for the flexor digitorum. And about three quarters of an inch nearer the os calcis is the interval in which the flexor pollicis lies, contained in a groove in the astragalus. Each sheath is lined by a synovial membrane.

Vessels beneath the ligament.—The posterior tibial vessels in passing beneath the ligament lie between the tendons of the flexor pollicis and flexor digitorum, but rather nearer the latter. The artery supplies here small branches to the tarsus and the ankle joint. Occasionally the artery divides beneath or even above the ligament.

The nerve is nearer than the artery to the os calcis; but it is sometimes bifurcated beneath the ligament, so that a nerve may lie on each side of the tibial vessels.

SECTION V.

THE SOLE OF THE FOOT.

- Position of the part.** *Position.*—The foot is to be placed over a block of little thickness with the sole towards the dissector, and the part is to be made tense by fixing the heel with hooks, and by fastening down and separating the toes.
- Raise the skin** *Dissection.*—The skin is to be raised as two flaps, inner and outer, by means of one incision along the centre of the sole from the heel to the anterior part, and by another across the foot at the root of the toes. Afterwards the skin is to be removed from each toe, and the lateral digital vessels and nerves are to be dissected out at the same time.
- and dissect cutaneous nerves.** In the fat near the heel the student should follow the cutaneous nerve of the sole of the foot (p. 735); and he may trace out, at a little distance from each border of the foot, some small branches of the plantar nerves and arteries.
- Subcutaneous fat.** The *subcutaneous fat* of the sole of the foot is very abundant, and forms the thickest cushion over the parts of the surface that press most on the ground in standing, viz., over the os calcis, and the line of the metatarso-phalangeal articulations.
- Lay bare the plantar fascia,** *Dissection.*—The fat should be now removed, and the plantar fascia laid bare. Beginning the dissection near the heel, follow forwards the fascia towards the toes, to each of which a process is to be traced. In the intervals between these processes the digital nerves and arteries will be detected amongst much fatty and fibrous tissues; but the vessels and nerves to the inner side of the great toe and outer side of the little toe, will be found piercing the fascia farther back than the rest.
- and the digital vessels and nerves.**
- Define the ligament of the toes.** The student is next to define a transverse fibrous band between the toes, over the digital vessels and nerves; and when this has been completed he may remove the superficial fascia from the toes to see the sheaths of the tendons.
- Plantar fascia.** **PLANTAR FASCIA.**—The special fascia of the sole of the foot is of a pearly white colour and great strength, and sends septa between the muscles. Its thickness varies in different parts of the foot; and from this circumstance, and from the existence of longitudinal depressions where the two chief intermuscular septa are attached, the fascia is divided into a central and two lateral parts.
- Division into parts.**
- Central part** The central part, which is much the thickest, is pointed



at its attachment to the os calcis, but widens and becomes thinner as it extends forwards. A slight depression, corresponding with an intermuscular septum, marks its limit on each side. Opposite the heads of the metatarsal bones it divides into five processes, which send bands to the integuments near the web of the foot, and are then continued on-wards to the toes, one to each. If one of the processes be divided longitudinally, and its parts reflected to the sides, it will be seen to join the sheath of the flexor tendons, and to be fixed also on the sides into the margins of the metatarsal bone and into the transverse metatarsal ligament. Where the processes separate from each other, the digital vessels and nerves and the lumbricales muscles become superficial, and transverse fibres arch over the intervals.

divides
into five
pieces.

Termination
of the
pieces.

Arched
fibres over
vessels.

The lateral parts of the fascia are thinner than the central piece. On the inner margin of the foot the fascia has but little strength, and is continued to the dorsum; but on the outer side it is increased in thickness, and presents a strong band between the os calcis and the projection of the fifth metatarsal bone.

Inner part
of the
fascia;

outer part.

Dissection.—To examine the septa, a longitudinal incision may be made along the middle of the foot, through the central piece of the fascia, and a transverse one near the calcaneum. On detaching the fascia from the subjacent flexor brevis digitorum, by carrying the scalpel from before backwards, the septal processes will appear on the sides of that muscle.

Expose the
septa.

The *intermuscular septa* pass down on the sides of the flexor brevis digitorum, and thus isolate the central muscle in the superficial layer of the sole of the foot. A piece of fascia reaches across the foot from the one septum to the other, beneath the short flexor.

Two inter-
muscular
septa.

The *inner septum* lies between the short flexor and the abductor pollicis, and is perforated by the internal plantar nerve, and the tendon of the flexor pollicis longus.

The *outer partition* between the short flexor and the abductor minimi digiti, is pierced by the digital nerve and artery for the outer side of the little toe.

and outer.

The *transverse ligament* crosses the roots of the toes, and is contained in the skin forming the rudimentary web of the foot. The band of fibres is attached at the extremities to the great and little toes, and is connected with each of the others as it passes over. Beneath it are the digital nerves and vessels.

Transverse
ligament of
the toes.

The *sheaths* of the *flexor tendons* are similar to those of

Flexor tendons.

the fingers, though not so distinct, and serve to confine the tendons against the grooved bones. The sheath is weak opposite the articulations between the phalanges, but is strengthened by a band opposite the centre of both the metatarsal and the next phalanx. Each is lubricated by a synovial membrane, and contains tendons of the long and short flexor muscles.

Dissect first layer of muscles.

Dissection.—In the sole of the foot the muscles are numerous, and have been arranged in four layers. To prepare the first layer all the fascia must be taken away, but this dissection must be made with some care, lest the digital nerves and vessels, which become superficial to the muscles towards the toes, should be injured. The tendons of the short flexor muscle are to be followed to the toes, and the sheaths in which they are contained should be opened.

Muscles in the first layer.

FIRST LAYER OF MUSCLES.—In the layer first visible are three muscles, viz., the flexor brevis digitorum, the abductor pollicis, and abductor minimi digiti. The short flexor of the toes is in the centre of the foot; and each of the others is in a line with the toe on which it acts.

Abductor pollicis;

The ABDUCTOR POLLICIS is the most internal of the muscles of the superficial layer. It takes *origin* from the inner part of the larger tubercle on the under surface of the os calcis; from the internal annular ligament, and the fibrous structures on the inner side of the foot as far as the internal cuneiform bone; and from the plantar fascia. In front the muscle ends in a tendon, which is joined by fibres of the short flexor, and is *inserted* with the flexor into the inner side of the base of the metatarsal phalanx of the great toe.

origin;

insertion;

connections.

The cutaneous surface of the muscle is in contact with the plantar fascia; and the other touches the plantar vessels and nerves, the tendons of the long flexors of the toes, and the accessory muscle.

Flexor brevis digitorum

The FLEXOR BREVIS DIGITORUM (flexor perforatus) *arises* posteriorly by a pointed tendinous process from the inner part of the larger tubercle of the os calcis, and by fleshy fibres from the plantar fascia and the septa. About the centre of the foot the muscle ends in four small tendons; these are directed forwards over the tendons of the long flexor, and entering the sheaths of the four smaller toes, are *inserted* into the middle phalanges. In the sheath of the toe, the tendon of this muscle lies at first (in this position of the foot) on the long flexor; but opposite the middle of the metatarsal phalanx it is slit for the passage of the other,

divides into tendons for the toes.

and is attached by two processes to the sides of the middle phalanx. Insertion.

The short flexor of the toes is contained in a sheath of the plantar fascia, and occupies the middle of the foot. It conceals the tendon of the long flexor of the toes, the accessory muscle, and the external plantar vessels and nerve. Connections.

The ABDUCTOR MINIMI DIGITI has a wide *origin* behind from the outer and inner tubercles of the os calcis, and from the plantar fascia and the external intermuscular septum. It ends anteriorly in a tendon which is *inserted* into the outer side of the base of the metatarsal phalanx of the little toe. Abductor of the little toe.
Origin and insertion.

The muscle lies along the outer border of the foot, and conceals the flexor accessorius, and the tendon of the peroneus longus. On its inner side are the external plantar vessels and nerve. Is at side of the foot.

Dissection.—To bring into view the second layer of muscles and the plantar vessels and nerves, the muscles already examined must be reflected. Cut through the flexor brevis at the os calcis, and as it is raised, notice a branch of nerve and artery to it. Dividing the abductor minimi digiti near its origin, and turning it to the outer side of the foot, seek a small nerve and vessel to it close to the calcaneum. The abductor pollicis can be drawn aside if it is necessary, but it should remain uncut till afterwards. Dissect the next muscular layer, and

Now the plantar vessels and nerves are to be followed forwards to their termination, and backwards to their origin; and the tendons of the long flexors of the toes, the accessory muscle, and the small lumbricales, should be freed from loose tissue. plantar vessels and nerves.

The PLANTAR ARTERIES are the terminal branches of the posterior tibial trunk. They are two in number, and are named external and internal from their relative position in the sole of the foot. Of the two the external is the larger; and it forms the plantar arch of arteries, from which digital branches are furnished to the toes. Two plantar arteries!
inner and outer.

The *internal* artery is commonly inconsiderable in size, and is directed forwards, under cover of the abductor pollicis, to the root of the great toe: there it ends either in small branches to the side of the foot, or in digital branches to the inner two toes which anastomose with the external plantar artery. Internal small:
ends on side of the foot.

The *external* artery supplies branches to the toes. It has an arched course in the foot, with the concavity of the arch turned inwards. From the inner part of the foot the vessel External artery has curved course;

- is directed outwards across the sole, and then obliquely inwards towards the root of the great toe, so that the vessel crosses the foot twice. In the first half of its extent, viz. from the inner side of the calcaneum to the base of the metatarsal bone of the little toe, the artery is comparatively superficial; in the other half, between the little and the great toe, it lies deeply in the foot, in contact with the interosseous muscles, and forms the plantar arch.
- partly superficial, partly deep. Only the first part of the artery is now laid bare; the remaining part, supplying the digital branches, will be noticed after the examination of the third layer of muscles (p. 744). As far as the metatarsal bone of the little toe, the vessel is concealed by the abductor pollicis and the flexor brevis digitorum, and for a short distance near its termination it lies in the interval between the last muscle and the abductor minimi digiti. In this extent it is placed on the os calcis, and the flexor accessorius; and it is accompanied by venæ comites, and the external plantar nerve.
- Superficial part. It supplies offsets to the muscles between which it lies, and some branches to the outer side of the foot for anastomosis with the peroneal artery.
- Connections. The PLANTAR NERVES are derived from the bifurcation of the posterior tibial nerve behind the inner ankle. They are two in number, like the arteries, and have the same connections as those vessels, for each accompanies a plantar artery; but the larger nerve is found with the smaller bloodvessel.
- Veins and nerve. The *internal plantar* nerve courses with its artery between the short flexor and the abductor pollicis, and divides into four digital branches for the supply of both sides of the inner three toes, and half the fourth; it resembles thus the median nerve of the hand in the number and distribution of its digital branches.
- Branches. Offsets are given by it to the short flexor and the abductor pollicis, and a few superficial twigs perforate the fascia.
- Plantar nerves also two. The four *digital* nerves have a numerical designation, and the first is nearest the inner border of the foot. The branch to the inner side of the great toe is undivided, but the others are bifurcated at the clefts between the toes.
- Inner is largest. Muscular branches are furnished by the nerves before they reach the toes; thus, the first (most internal) supplies the flexor brevis pollicis; the second, the inner lumbrical muscle; and the third, the next lumbrical muscle.
- Internal nerve to three toes and a half. *Digital nerves on the toes.*—Each of the outer three nerves, being divided at the spot mentioned, supplies cutaneous
- Other branches.
- Digital nerves are divided except first;
- muscular branches;
- two cutaneous

offsets to the contiguous sides of two toes, and to the cutis beneath the nail; and articular filaments are distributed to the joints, as in the fingers.

The *external plantar* nerve furnishes the remaining digital nerves to both sides of the little toe, and the outer side of the next, and ends in the deep muscles of the sole of the foot. This nerve corresponds in its arrangement with the ulnar nerve in the hand. It has the same course as the external plantar artery, and divides at the outer margin of the flexor brevis digitorum into a superficial and a deep portion:—the former gives origin to two digital nerves; but the latter accompanies the arch of the plantar artery into the foot, and will be dissected afterwards.

Whilst the external plantar nerve is concealed by the short flexor of the toes, it gives muscular branches to the abductor minimi digiti and the flexor accessorius.

The *digital branches* of the external plantar nerve are but two, and resemble those of the ulnar nerve in the hand.

One nerve is undivided; it is distributed to the outer side of the little toe, and gives branches to the flexor brevis minimi digiti, and the interosseous muscles of the fourth space.

The other bifurcates at the cleft between the outer two toes, and supplies their collateral surfaces: this nerve communicates in the foot with the last digital branch of the internal plantar nerve.

On the sides of the toes the digital nerves have the same distribution as those from the other plantar trunk.

Dissection.—To complete the preparation of the second layer of muscles, the origin of the abductor pollicis should be detached from the os calcis, and the muscle should be turned inwards. The internal plantar nerve and artery, and the superficial portion of the external plantar nerve, are to be cut across and thrown forwards; but the external plantar artery and the nerve with it are not to be injured. All the fat and loose tissue and fascia are to be taken away near the toes.

— SECOND LAYER OF MUSCLES. —In this layer are the tendons of the two flexor muscles at the back of the leg, viz. flexor longus digitorum and flexor longus pollicis, which cross one another. Connected with the former, soon after it enters the foot, is an accessory muscular slip; and at its division into pieces are four slender muscles named lumbricales.

The tendon of the FLEXOR LONGUS DIGITORUM, whilst entering the foot beneath the annular ligament, lies on the

and articu-
lar offsets.

External
nerve to one
toe and a
half;

has super-
ficial and
deep parts.

Branches.

Two digital
branches.

One single.

One divided.

Distribution
like others.

Lay bare
second
layer of
muscles.

Second
layer.

Tendon of
the flexor of
the toes

- internal lateral ligament of the ankle joint. In the foot it is directed obliquely towards the centre, where it is joined by the tendon of the flexor longus pollicis and the accessory muscle, and divides into tendons for the four outer toes. Each tendon enters the sheath of the toe with, and beneath a tendon from the flexor brevis. About the centre of the metatarsal phalanx the long flexor tendon is transmitted through the other, and passes onwards to be inserted into the base of the ungual phalanx. The flexor longus digitorum is sometimes increased in size by its junction with the long flexor of the great toe.
- divides into four.
- These pierce the other tendons.
- Ligaments to tendons.
- Four lumbricales.
- Attachment to toes and long flexor.
- Flexor accessorius
- is joined with flexor longus.
- Insertion of tendon of flexor pollicis.
- Connections.
- In the foot there are ligamentous bands (lig. brevia) to the flexor tendons as in the hand, and the one fixing the flexor perforans is provided also with elastic tissue. See p. 323.
- The *lumbricales* are four small muscles between the tendons of the flexor longus digitorum. Each arises from two tendons, with the exception of the most internal one which is connected with the inner side of the tendon to the second toe. Each is inserted into the tibial side of the base of the metatarsal phalanx in the four outer toes; and from the insertion an expansion is prolonged to the dorsum of the phalanx to join the aponeurotic covering on it. These muscles decrease in size from the inner to the outer side of the foot.
- The *accessorius muscle* has two heads of origin:—One is tendinous, and is attached to the under or the outer surface of the os calcis and the ligamentum longum plantæ; the other is large and fleshy, and springs from the inner or concave surface of the calcaneum. The fibres end in aponeurotic bands, which join the tendon of the flexor longus digitorum about the centre of the foot, so as to form a kind of groove for it. The muscle is bifurcated behind, and the heads of origin are separated by the long plantar ligament. On it are the external plantar vessels and nerve, and the flexor brevis digitorum conceals it.
- The tendon of the FLEXOR LONGUS POLLICIS is deeper in the sole of the foot than the flexor longus digitorum, to which it is united by a strong tendinous process. Finally directed to the root of the great toe, it enters the digital sheath, and is inserted into the base of the ungual phalanx. Between the calcaneum and the internal malleolus this tendon lies in a groove in the astragalus; and in the foot it occupies a groove below the inner projection (sustentaculum tali) of the os calcis.

Dissection.—For the dissection of the third layer of muscles, the accessorius and the tendons of the long flexor are to be cut through near the calcaneum, and turned towards the toes. Whilst raising the tendons the external plantar nerve and artery are not to be interfered with, and two small nerves to the outer two lumbricales are to be looked for. Afterwards the areolar tissue is to be taken from the muscles now brought into view.

Dissect
third layer
of muscles.

THIRD LAYER OF MUSCLES.—Only the short muscles of the great and little toes enter into this layer. On the metatarsal bone of the great toe the flexor brevis pollicis lies, and external to it is the adductor pollicis; on the metatarsal bone of the little toe is the flexor brevis minimi digiti. Crossing the heads of the metatarsal bones is the transversalis pedis muscle. The fleshy mass between the adductor pollicis and the short flexor of the little toe consists of the interossei muscles of the next layer.

Third layer
of muscles.

The FLEXOR BREVIS POLLICIS muscle is tendinous and pointed at the posterior part, but bifurcated in front. It is attached posteriorly to the inner border of the cuboid bone, and to a prolongation from the tendon of the tibialis posticus to the outer two cuneiform bones. Near the front of the metatarsal bone of the great toe it divides into two heads, which are inserted into the sides of the base of the metatarsal phalanx.

Flexor bre-
vis pollicis.

Origin.

Insertion.

Resting on the muscle at one part, and in the interval between the heads at another, is the tendon of the flexor longus pollicis. The inner head joins the abductor, and the outer is united with the adductor pollicis. A sesamoid bone is developed in the tendon connected with each head.

Conne-
ctions.

The ADDUCTOR POLLICIS, which is larger than the preceding muscle and external to it, arises from the sheath of the tendon of the peroneus longus, and from the bases of the third and fourth metatarsal bones. Anteriorly the muscle is united with the outer head of the short flexor, and is inserted with it into the base of the metatarsal phalanx of the great toe. To the inner side is the flexor brevis; and beneath the outer border the external plantar artery and nerve are directed inwards.

Adductor
pollicis

joins outer
head of
short flexor.

Covers
plantar
arch.

The TRANSVERSALIS PEDIS is placed transversely over the heads of the metatarsal bones. Its origin is by fleshy bundles from the transverse ligament uniting the heads of the four outer metatarsal bones, and from their phalangeal articulations (frequently not from the little toe); and its insertion into the great toe is united with that of the adductor pollicis.

Transversa-
lis pedis.

Origin.

Insertion.

Connections.

The cutaneous surface is covered by the tendons, and the vessels and nerves of the toes; and the opposite surface is in contact with the interossei muscles.

Flexor minimi digiti is like an interosseous.

The FLEXOR BREVIS MINIMI DIGITI is a small narrow muscle; it lies on the metatarsal bone of the little toe, and resembles one of the interossei. Attached to the metatarsal bone, and to the sheath of the peroneus longus behind, it blends with the inferior ligament of the metatarso-phalangeal articulation, and is inserted with it into the base of the metatarsal phalanx of the toe.

Dissect the deep vessels and nerves.

Dissection.—In order that the deep vessels and nerves may be seen, the flexor brevis and adductor pollicis are to be cut through at the posterior part, and thrown towards the toes; but the nerves supplying them are to be preserved. Beneath the adductor is the plantar arch, and the external plantar nerve, with their branches; and in the first interosseous space is the part of the dorsal artery of the foot that enters the sole. All these vessels and nerves require careful cleaning. The muscles projecting between the metatarsal bones are the interossei.

Arch of the plantar artery.

The PLANTAR ARCH is the part of the external plantar artery that reaches from the base of the metatarsal bone of the little toe to the back of the first interosseous space (p. 739): internally the arch is completed by a communicating branch from the dorsal artery of the foot. It is placed across the tarsal ends of the metatarsal bones in contact with the interossei, being between the third and fourth layers of muscles in the foot. From the front or convexity of the arch the digital branches are supplied, and from the opposite side small muscular branches arise.

Extent and connections with muscles.
Branches.

From the under part are given off three small arteries, the *posterior perforating*; these pass to the dorsum of the foot through the three outer intermetatarsal spaces, and anastomose with the interosseous branches of the anterior tibial artery.

Posterior perforating.

Digital branches to three toes and a half.

The *digital branches* are four in number, and supply both sides of the three outer toes, and half of the next. The one to the outer side of the little toe is single; the others lie over the outer three metatarsal spaces, and bifurcate in front to supply the contiguous sides of two toes.

Anterior perforating offsets.

Where they divide, they send small communicating branches—*anterior perforating*, to the interosseous arteries on the dorsum of the foot.

Distribution on the toes.

On the sides of the toes the disposition of the arteries is like that in the hand. They extend to the last phalanx,

where they unite in an arch, and give offsets to the ball of the toe; and near the front of both the metatarsal and the next phalanx, they form anastomotic loops beneath the tendons, from which the phalangeal articulations are supplied.

The DORSAL ARTERY OF THE FOOT enters the sole at the posterior part of the first (inner) intermetatarsal space, and supplies digital offsets to both sides of the great toe and to half the next, in the same manner as the radial artery in the hand is distributed to one digit and a half. Besides these, it furnishes a communicating branch to join the plantar arch.

Ending of
the dorsal
artery of
the foot;

The *digital branch* (art. magna pollicis) extends to the front of the first interosseous space, and divides into collateral branches for the great toe and the next. Near the front of the metatarsal bone it sends inwards, beneath the flexor muscles, a digital branch for the inner side of the great toe.

its digital
branches,

These arteries have the same arrangement along the toes as the other digital branches.

on the
digits.

EXTERNAL PLANTAR NERVE.—The *deep branch* of this nerve accompanies the arch of the artery, and ends internally in the adductor pollicis. It furnishes branches to all the interossei, one or both in the external space excepted; to the transversalis pedis; and to the external two lumbrical muscles.

External
plantar
nerve ends
in the deep
muscles.

Dissection.—It will be needful to remove the transversalis pedis muscle, to see a ligamentous band across the heads of the metatarsal bones.

Dissection.

The *transverse metatarsal ligament* is a strong fibrous band, like that in the hand (p. 327), which connects together the anterior extremities of all the metatarsal bones. A thin fascia covering the interossei muscles is connected to its hinder part. It is concealed by the transversalis pedis, and by the tendons, vessels, and nerves of the toes.

Transverse
metatarsal
ligament.

Dissection.—To complete the dissection of the last layer of muscles, the flexor brevis minimi digiti may be detached and thrown forwards. Dividing then the metatarsal ligament between the bones, the knife is to be carried directly backwards in the centre of each interosseous space except the first, in order that the two interossei muscles may be separated from each other. The fascia covering the muscles should be taken away, and the branches of the external plantar nerve to them should be dissected out. All the interossei are visible in the sole of the foot.

Dissect the
last layer of
the muscles.

FOURTH LAYER OF MUSCLES.—In the fourth and last layer

Fourth

layer of
muscles.

Interossei,
are

plantar and
dorsal.

of the foot are contained the interossei muscles, and the tendons of the tibialis posticus and peroneus longus muscles.

The INTEROSSEI MUSCLES are situate in the intervals between the metatarsal bones. They consist of two sets, plantar and dorsal, like the interossei in the hand. Seven in number, there are three plantar and four dorsal; and two are found in each space, except in the innermost.

Fig. 106.*



Fig. 107.†



Three plan-
tar for three
outer toes.

The *plantar interossei* belong to the three outer metatarsal bones. They arise from the under and inner surfaces of the bones, and are inserted into the tibial side of the base of the metatarsal phalanx of the same toes; and an expansion is continued from each to the extensor tendon on the dorsum of the phalanx. These muscles are smaller than the dorsal, and are placed more in the sole of the foot.

Action.

By their action they would approximate the three outer toes to the middle one.

Four dorsal

The *dorsal interossei*, one in each space, arise from the

* The plantar interosseous muscles of the foot—the figures refer to the three muscles.

† The four dorsal interossei muscles are indicated by the figures.

lateral surfaces of the two bones between which they lie, and are inserted into the side of the metatarsal phalanx of certain toes:—Thus, the internal two muscles are attached to the second toe, one to each side; the next to the outer side of the third toe, and the remaining one to the outer side of the fourth toe. An expansion is continued from the tendons to the extensors on the dorsum of the phalanges. The posterior perforating arteries pierce the hinder extremities of the muscles. These small muscles will be partly seen on the dorsum of the foot.

The attachment of the dorsal muscles to the toes may be remembered by considering them abductors as in the hand (p. 328) from the middle line of the second digit:—the outer two muscles will draw their respective toes from the rest; and the two connected with the second digit will move it to the right or the left of the line referred to.

Dissection.—Following the tendon of the tibialis posticus muscle from its position behind the inner malleolus to its insertion into the scaphoid bone, trace the numerous processes that it sends forwards and outwards. Open also the fibrous sheath of the tendon of the peroneus longus, which crosses from the outer to the inner side of the foot.

The tendon of the TIBIALIS POSTICUS is continued forwards over the internal lateral ligament of the ankle joint, and over the articulation between the astragalus and the os scaphoides, to be inserted into the prominence of the latter bone. From its insertion processes are continued to many of the other bones of the foot.

One is directed backwards to the margin of the groove in the os calcis for the tendon of the flexor longus pollicis. Two offsets are directed forwards:—one is prolonged to the internal cuneiform bone; the other, much the largest, is attached to the middle and outer cuneiform, to the os cuboides, and to the bases of the second, third, and fourth metatarsal bones. Where the tendon is placed beneath the articulation of the astragalus, it contains a sesamoid bone, or fibro-cartilage.

The tendon of the PERONEUS LONGUS MUSCLE winds round the cuboid bone, and placed in the groove on the under surface, is continued inwards to be inserted into the internal cuneiform bone, and into the base of the metatarsal bone of the great toe; it sends a process also to the base of the second metatarsal bone.

In the sole of the foot (fig. 106) it is contained in a sheath which is formed, for the most part, by the fibres of

between the bones.

Attachments.

Action of the muscles.

Trace out the deep tendons.

Insertion of tendon of tibialis posticus

into tarsus

and metatarsus.

Insertion of tendon of peroneus longus.

Connection.

the long plantar ligament prolonged to the tarsal ends of the third and fourth metatarsal bones. A separate synovial membrane lubricates the sheath. Where the tendon turns round the cuboid bone it is thickened, and contains fibro-cartilage or a sesamoid bone.

SECTION VI.

THE FRONT OF THE LEG.

Position of
the limb.

Position.—The limb is to be raised to a convenient height by blocks placed beneath the knee, and the foot is to be extended in order that the muscles on the front of the leg may be put on the stretch.

Raise the
skin.

Dissection.—To enable the dissector to raise the skin from the leg and foot, one incision should be made along the middle line from the knee to the toes, and this should be intersected by cross cuts at the ankle and the web of the foot.

Seek the
cutaneous
nerves in
the leg;

After the flaps of skin are reflected, the cutaneous vessels and nerves are to be looked for (fig. 108). At the inner part of the leg are some filaments from the great saphenous nerve; and at the outer side, others from the cutaneous ramifications of the external popliteal nerve. Perforating the fascia in the lower third, on the anterior aspect, is the musculo-cutaneous nerve, whose branches should be pursued to the toes.

on the foot
both vessels
and nerves.

On the dorsum of the foot is a venous arch, which ends at the sides in the saphenous veins. On the outer side is the short saphenous nerve; and in the interval between the great toe and the next, is the cutaneous part of the anterior tibial nerve. The nerves should be traced to the ends of the toes by removing the integuments.

Clean the
fascia.

After the several vessels and nerves are dissected, the fat is to be taken away, in order that the fascia may be seen.

Cutaneous
veins.

The *venous arch on the dorsum of the foot* has its convexity turned forwards, and receives digital branches from the toes; at its concavity it is joined by small veins from the instep. Internally and externally it unites with the saphenous veins.

Internal
saphenous.

The *internal saphenous vein* begins at the inner side of the great toe, and in the arch of veins. It ascends along the inner side of the foot, and in front of the inner ankle to

the inner part of the leg, where it has been before seen (p. 727). Branches enter it from the inner side and the sole of the foot.

The *external saphenous vein* begins on the outside of the little toe and the foot, as well as in the venous arch; and it is continued below the outer ankle to the back of the leg (p. 727). External saphenous.

CUTANEOUS NERVES.—All the superficial nerves on the front of the leg and foot are derived from branches of the popliteal trunks, viz. from the musculo-cutaneous and anterior tibial nerves of the external popliteal, and from the external saphenous nerve of the internal popliteal. Some inconsiderable offsets to the sides of the leg from the internal saphenous and external popliteal do not require separate notice. Source of the cutaneous nerves.

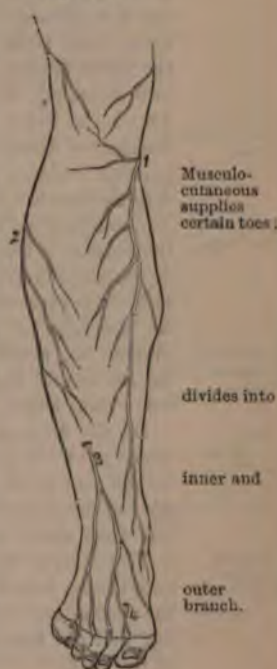
The *musculo-cutaneous nerve* (fig. 108,³) has a cutaneous termination, and its place of destination is the dorsum of the foot and toes. Perforating the fascia in the lower third of the leg, it divides into two principal branches (inner and outer), which give digital nerves to the sides of all the toes, except the outer part of the little toe and the contiguous sides of the great toe and the next. The digital branches may be traced in the integument as far as the end of the last phalanx.

a. The *inner branch* communicates with the internal saphenous nerve, and supplies the inner side of the foot and great toe: it joins also the anterior tibial nerve.

b. The *outer branch* divides into three nerves; these lie over the three outer interosseous spaces, and bifurcate at the web of the foot for the supply of the contiguous sides of the four toes corresponding with those spaces: it joins the external saphenous nerve on the outer part of the foot.

The *anterior tibial nerve* (fig. 108,⁴) becomes cutaneous in the first interosseous space, and is distributed to the Anterior tibial, where found.

Fig. 108.*



* Cutaneous nerves of the front of the leg and foot.—1. Internal saphenous when superficial. 2. Offsets of the cutaneous branch of the external popliteal. 3. Musculo-cutaneous. 4. Anterior tibial.

opposed sides of the great toe and the next. The musculo-cutaneous nerve joins it, and sometimes assists in supplying the same toes.

External
saphenous.

The *external saphenous nerve* comes from the back of the leg below the outer ankle, and is continued along the foot to the outside of the little toe. Occasionally it supplies both sides of the little toe, and part of the next or more.

Deep fascia
of the leg ;

attach-
ments ;

The *fascia of the front of the leg* is thickest near the knee joint, where it gives origin to muscles. It is fixed internally and externally into the tibia and fibula. Intermuscular septa are prolonged from the deep surface, and one of these, which is attached to the fibula, separates the muscles on the front from those on the outer side of the leg. Superiorly the fascia is connected to the heads of the bones of the leg, but inferiorly it is continued to the dorsum of the foot. Above and below the ankle joint it is strengthened by some transverse fibres, and gives origin to the two parts of the anterior annular ligament ; and below the end of the fibula it forms another band, the external annular ligament.

transverse
fibres at the
ankle.

Take away
the fascia.

Dissection.—The fascia is to be removed from the leg and the dorsum of the foot, but the thickened band of the annular ligament both above and below the end of the tibia is to be left. On separating the fascia from the subjacent muscles, let the edge of the scalpel be directed upwards. In like manner the fascia may be taken from the peronei muscles on the outside of the fibula, but without destroying the band below that bone.

Leave liga-
mentous
bands.

Clean
nerves and
vessels.

On the dorsum of the foot the dorsal vessels with their nerve are to be dissected, and the short and long extensors of the toes are to be traced to the ends of the digits. In the leg the anterior tibial nerve and vessels are to be followed into their intermuscular space and then cleaned.

Anterior
annular
ligament ;

The *anterior annular ligament* consists of two parts, upper and lower, which confine the muscles in their position :—the former serving to bind the fleshy part to the bones of the leg, and the latter to keep down the tendons on the dorsum of the foot.

its upper

The *upper part* is attached laterally to the bones of the leg, and possesses a separate sheath for the tibialis anticus.

and lower
part.

The *lower part* is in front of the tarsal bones. It is inserted externally by a narrow part into the upper surface of the os calcis, in front of the depression for the interosseous ligament ; and internally where it is thin and widened, into the plantar fascia and the inner malleolus. In this part of the ligament there are three sheaths :—the inner one for the

Sheaths
differ in
sh.

tibialis anticus; the next for the extensor pollicis; and the outer one for the extensor longus digitorum and peroneus tertius. Separate synovial membranes line the sheaths.

The *external annular ligament* is attached on the one side to the outer malleolus, and on the other to the outer surface of the os calcis; it contains the two lateral peronei muscles in one sheath lined by a synovial membrane.

External
annular
ligament.

The MUSCLES ON THE FRONT OF THE LEG are three in number; they are flexors of the ankle and extensors of the toes. The large muscle next the tibia is the tibialis anticus, and that next the fibula, the extensor longus digitorum; whilst a small muscle, apparently the lower part of the last, with a separate tendon to the fifth metatarsal bone, is the peroneus tertius. The muscle between the tibialis and extensor digitorum, in the lower half of the leg, is the extensor pollicis.

Muscles on
the front of
the leg

On the dorsum of the foot is only one muscle, the extensor and foot. brevis digitorum.

The TIBIALIS ANTICUS reaches the tarsus: it is thick and fleshy in the upper, but tendinous in the lower part of the leg. It *arises* from the outer tuberosity and the upper two-thirds of the tibia; from the contiguous part of the interosseous ligament; and from the fascia of the leg and the intermuscular septum between it and the next muscle. After passing through the innermost compartments in the annular ligaments, the tendon is *inserted* into the under surface of the internal cuneiform bone, and sends forwards a process to the metatarsal bone of the great toe.

Tibialis
anticus:
origin,

insertion.

The muscle is sub-aponeurotic. It lies at first outside the tibia, resting on the interosseous membrane, but it is then placed successively over the end of the tibia, the ankle joint, and the inner line of the tarsal bones. The outer border touches the extensor muscles of the toes, and conceals partly the anterior tibial vessels as low as the foot.

Parts be-
neath the
muscle and
on the sides.

The EXTENSOR PROPRIUS POLLICIS is deeply placed at its origin between the former muscle and the extensor longus digitorum, but its tendon becomes superficial on the dorsum of the foot. The muscle *arises* from the middle three-fifths of the narrow anterior part of the inner surface of the fibula, and from the interosseous ligament for the same distance. The tendon comes to the surface through a sheath in the lower part of the annular ligament, and continues over the inner part of the tarsus to be *inserted* into the last phalanx of the great toe.

Extensor
pollicis

attached to
fibula,
and great
toe;

The anterior tibial vessels are to the inner side of the

It crosses
the vessels.

muscle as low as the sheath in the ligament, but afterwards to the outer side of its tendon, so that they are crossed by it beneath the ligament.

Extensor
longus
arises from
fibula;

The EXTENSOR LONGUS DIGITORUM (fig. 109), like the tibial muscle, is fleshy in the leg and tendinous on the foot. Its *origin* is from the external tuberosity of the tibia; from the head and three-fourths of the narrow surface of the fibula; from a small part (about an inch above) of the interosseous membrane; and from the fascia of the leg and the intermuscular septum on each side. The tendon enters its sheath in the annular ligament with the peroneus tertius, and divides into four pieces. Below the ligament these tendons are continued to the four outer toes, and are *inserted* into the middle and ungual phalanges.

inserted
into four
outer toes.

Arrange-
ment of
the tendons
on the toes.

On the phalanges of the toes the tendons have the same arrangement as in the hand. For on the metatarsal phalanx, the tendons of the long and short extensor join with prolongations from the interossei and lumbricales to form a membranous expansion. At the further end of this phalanx the expansion is divided into three parts—a central and two lateral; the central piece is inserted into the base of the middle phalanx, while the lateral unite at the front of that bone, and are fixed into the ungual phalanx.

Connections
of the mus-
cle.

In the leg the muscle is placed between the peroneus on the one side, and the tibialis anticus and extensor proprius pollicis on the other. It lies on the fibula, and on the lower end of the tibia and the ankle joint. On the foot the tendons rest on the extensor brevis digitorum; and the vessels and nerve of this part are internal to them.

Peroneus
tertius.

Origin.

The *peroneus tertius* is situate below the extensor longus digitorum, from which it is seldom separate at its origin. It arises from the lower fourth of the surface of the fibula, from the lower end of the interosseous ligament, and from the intermuscular septum between it and the peroneal muscles. And it is *inserted* by a tendon into the upper surface of the metatarsal bone of the little toe near the tarsal end. This muscle has the same connections in the leg as the lower part of the long extensor, and is contained in the same space in the annular ligament.

Insertion.

Anterior
tibial
artery;

course and
extent.

The ANTERIOR TIBIAL ARTERY extends from the bifurcation of the popliteal trunk to the front of the ankle joint. At this spot it loses the name tibial, and is called the dorsal artery of the foot. The course of the artery is forwards through the aperture in the upper part of the interosseous membrane, and then along the front of that membrane and

the tibia to the foot. A line from the inner side of the head Direction.
of the fibula to the centre of the ankle will mark the position
of the vessel.

Fig. 109.*



For a short distance (about two inches) the artery lies Connections
between the tibialis anticus and the extensor longus digi- with parts
around.

* Anterior tibial vessels and muscles (from Quain's Arteries).—

torum; and it is placed afterwards between the tibial muscle and the extensor proprius pollicis, but towards the lower end of the vessel the last muscle becomes superficial, and crosses to the inner side. The artery rests on the interosseous membrane in two thirds of its extent, and is overlapped by the fleshy bellies of the contiguous muscles, so that it is at a great depth from the surface; but it is in front of the tibia and the ankle joint in the lower third, and is comparatively superficial, for it here lies between the tendons of the muscles.

Position of
veins

and nerve.

Venæ comites entwine around the artery, covering it very closely with cross branches on the upper part. The anterior tibial nerve approaches the tibial vessels about the middle third of the leg, and continues with them, crossing once or twice. At the lower end of the artery the nerve is on the outer side.

Branches.

Muscular
cutaneous.

Branches.—In the leg the anterior tibial artery furnishes mostly *muscular* offsets, but near the knee and ankle joints other named branches take origin. A *cutaneous* branch accompanies the musculo-cutaneous nerve.

Recurrent.

1. A *recurrent branch* leaves the trunk as soon as this appears above the interosseous membrane, and ascends in the tibialis anticus muscle to the knee joint. On the joint it anastomoses with the other articular arteries.

Malleolar,

inner
and outer.

2. *Malleolar arteries* (internal and external) arise near the ankle joint, and, as their name expresses, are distributed over the ends of the tibia and fibula. The internal is the least regular in size and origin; the external anastomoses with the anterior peroneal artery.

Articular.

3. Some small *articular branches* are supplied from the lower end of the artery to the ankle joint.

Dorsal
artery.

Extent and
course.

The **DORSAL ARTERY** of the foot is the continuation of the anterior tibial, and extends from the front of the ankle joint to the posterior part of the first interosseous space. At this interval it passes downwards between the heads of the interosseous muscle, to end in the sole as before described (p. 745).

Con-
nections.

The artery is supported by the inner row of the tarsus, viz. the astragalus and the scaphoid and cuneiform bones; and it is covered by the integuments and the deep fascia, but near its termination it is crossed by the inner tendon of the extensor brevis muscle. The tendon of the extensor pollicis is on the inner side; and the tendon of the

1. Tibialis anticus muscle.
2. Extensor pollicis and extensor longus digitorum drawn aside.
3. Part of the anterior annular ligament.
4. Anterior tibial artery: the nerve outside it is the anterior tibial.

extensor brevis digitorum is on the outer side, except for about half an inch before the artery dips into the sole of the foot, where it crosses as before said to the inner side of the vessel. The veins have the same position with respect to the artery as in the leg, and the nerve is external to it.

Position of
veins and
nerve.

Branches.—Offsets are given to the bones and the ligaments of the foot: those from the outer side of the vessel have received the names tarsal and metatarsal from their distribution. A small interosseous branch is furnished to the first intermetatarsal space.

Branches.

1. The *tarsal branch* arises opposite the scaphoid bone, and runs beneath the extensor brevis digitorum to the outer side of the foot, where it divides into twigs that inosculate with the metatarsal, plantar, and peroneal arteries: it supplies offsets to the extensor muscle beneath which it lies.

2. The *metatarsal branch* takes an arched course to the outer part of the foot, near the base of the metatarsal bones and beneath the extensor muscle, and its terminal branches anastomose with the external plantar and tarsal arteries.

Metatarsal.

From the convexity of the arch of the preceding branch, which is turned forwards, three *interosseous* arteries are furnished to the three outer intermetatarsal spaces: these supply the interosseous muscles, and divide at the cleft of the toes into two dorsal collateral branches. At the fore part and back of the spaces the interosseous arteries join the deep vessels in the sole of the foot by means of the anterior and posterior perforating arteries.

which gives
interos-
seous.

The *first interosseous branch* (arteria dorsalis pollicis pedis) arises from the trunk of the artery as this is about to leave the dorsum of the foot; it extends forwards in the space between the first two toes, and is distributed like the other interosseous offsets of the metatarsal branch.

First inter-
osseous.

The ANTERIOR TIBIAL VEINS have the same extent and connections as the artery they accompany. They have their usual position along the artery, one on each side, around which they form loops by cross branches; they end in the popliteal vein. The branches they receive correspond with those of the artery; and they communicate with the internal saphenous vein.

Anterior
tibial veins.

Peculiarities in size.—The anterior tibial may be small, or even wanting, in which case the place of its diminished or deficient part will be supplied by the posterior tibial or the peroneal artery.

Varieties in
anterior
tibial

Position.—On the dorsum of the foot the artery is often removed farther outwards than the line from the centre of the ankle to the posterior part of the first interosseous space.

- and dorsal artery. *Substitution.*—The place of the dorsal artery of the foot may be taken by a large anterior peroneal artery.
- Divide extensor longus. *Dissection.*—To examine the extensor brevis digitorum on the dorsum of the foot, cut through the tendons of the extensor longus and peroneus tertius below the annular ligament, and throw them towards the toes. The attachment of the muscle to the os calcis should be defined.
- Extensor brevis The EXTENSOR BREVIS DIGITORUM is a short thin muscle on the dorsum of the foot. It arises from the outer surface of the os calcis in front of the groove for the peroneus brevis muscle, and from the lower band of the anterior annular ligament; the muscle ends in four tendons, which spring from as many fleshy bellies, and are inserted into the four inner toes. The tendon to the great toe has a distinct attachment to the base of the metatarsal phalanx; but the rest are united to the outer side of the tendons of the long extensor, and assist to form the expansion on the metatarsal phalanx (p. 752). The muscle lies on the tarsus, and is partly concealed by the tendons of the long extensor. Its inner tendon crosses the dorsal artery of the foot.
- sends tendons to four inner toes. *Dissection.*—The branches of artery and nerve which are beneath the extensor brevis will be laid bare by dividing that muscle near its front, and turning it upwards. By cutting through the lower band of the annular ligament over the tendon of the extensor pollicis, and throwing outwards the external half of it,—the different sheaths of the ligament, its attachment to the os calcis, and the origin of the extensor brevis digitorum from it may be observed.
- Insertion of these. The anterior tibial and musculo-cutaneous nerves are to be followed upwards to their origin from the external popliteal; and a small branch to the knee joint from the same source is to be traced through the tibialis anticus.
- Cut through extensor brevis. NERVES TO THE FRONT OF THE LEG.—Between the fibula and the peroneus longus muscle the external popliteal nerve divides into the recurrent articular, musculo-cutaneous, and anterior tibial branches.
- Follow up the nerves. The recurrent articular branch is small, and takes the course of the artery of the same name through the tibialis anticus muscle to the knee joint.
- Nerves of the front of the leg. The musculo-cutaneous nerve is continued between the extensor longus digitorum and the peronei muscles to the lower third of the leg, where it pierces the fascia, and is distributed to the dorsum of the foot and the toes (p. 749). Before the nerve becomes cutaneous it furnishes branches to the two larger peronei muscles.
- Recurrent. The musculo-cutaneous nerve is continued between the extensor longus digitorum and the peronei muscles to the lower third of the leg, where it pierces the fascia, and is distributed to the dorsum of the foot and the toes (p. 749). Before the nerve becomes cutaneous it furnishes branches to the two larger peronei muscles.
- Musculo-cutaneous The musculo-cutaneous nerve is continued between the extensor longus digitorum and the peronei muscles to the lower third of the leg, where it pierces the fascia, and is distributed to the dorsum of the foot and the toes (p. 749). Before the nerve becomes cutaneous it furnishes branches to the two larger peronei muscles.
- supplies peronei. The musculo-cutaneous nerve is continued between the extensor longus digitorum and the peronei muscles to the lower third of the leg, where it pierces the fascia, and is distributed to the dorsum of the foot and the toes (p. 749). Before the nerve becomes cutaneous it furnishes branches to the two larger peronei muscles.

The *anterior tibial nerve* (interosseous) is directed inwards beneath the *extensor longus digitorum* (fig. 109) and reaches the tibial artery about the middle of the leg. From this spot it takes the course of the vessel along the foot to the first interosseous space, in which it ends on the surface (p. 749). In the leg it crosses the anterior tibial artery once or more, but its position on the foot is generally external to the dorsal artery.

Anterior tibial is with the artery.

Branches.—In the leg the nerve supplies the anterior tibial muscle and the extensors of the toes. On the dorsum of the foot it gives a considerable branch to the short extensor; this becomes enlarged, and gives offsets to the articulations of the foot.

Branches to muscles.

MUSCLES ON THE OUTER PART OF THE LEG.—Only two muscles are found in this situation: they are named *peronei* from their attachment to the fibula, and are distinguished by terms (*longus* and *brevis*) expressive of their relative length. Intermuscular processes of fascia, which are attached to the fibula, isolate these muscles from others, viz., from the *soleus* and *flexor pollicis* behind, and from the *extensor longus digitorum* in front.

External muscles of the leg.

The **PERONEUS LONGUS** is the more superficial of the two muscles, and passes into the sole of the foot round the outer border to end in the cuneiform and metatarsal bones. It arises from the head of the fibula; from the outer surface of the shaft of the bone for about two thirds of its length, but still farther from the posterior border; and from the fascia and the intermuscular septa. Inferiorly it ends in a tendon which is contained, with that of the *peroneus brevis*, in the groove at the back of the external malleolus, and in the sheath of the external annular ligament. Afterwards the tendon is continued in a separate sheath, below the *peroneus brevis*, along the side of the *os calcis* and through the groove in the outer border of the cuboid bone, to the sole of the foot. Its position in the foot, and its insertion into the tarsal and the metatarsal bones, are described before (p. 747).

Peroneus longus.

Origin from the fibula;

insertion into bones of the foot.

In the leg the muscle is immediately beneath the fascia, and lies on the *peroneus brevis*. Beneath the annular ligament it is placed over the middle piece of the external lateral ligament of the ankle with the *peroneus brevis*, and is surrounded by a single synovial membrane common to both. The *extensor longus digitorum* and the *soleus* muscles are fixed to the fibula laterally with respect to it, one being on each side.

Position in the leg.

The **PERONEUS BREVIS** reaches the outer side of the foot, *Peroneus*

brevia is
attached to
fibula,

and bone of
the little
toe.

Con-
nec-
tions.

and is connected with the metatarsal bone of the little toe. It is smaller than the preceding muscle, and inferior to it in position. The muscle arises from the outer surface of the shaft of the fibula for about the lower two thirds, extending upwards internal to the other peroneus ; and from the inter-muscular septa. Its tendon passes with that of the peroneus longus beneath the external annular ligament, and is placed next the fibula as it turns below this bone. Escaped from the ligament, the tendon enters a distinct fibrous sheath, which conducts it along the tarsus to its insertion into the projection of the base of the metatarsal bone of the little toe.

In the leg the muscle projects in front of the peroneus longus. On the outer side of the os calcis it is contained in a sheath above the tendon of the former muscle ; and each sheath is lined by a prolongation from the common synovial membrane behind the outer ankle.

SECTION VII.

LIGAMENTS OF THE KNEE, ANKLE, AND FOOT.

Examine
first the
knee joint.

Directions.—In examining the remaining articulations of the limb, the student may take first the knee joint, unless this has become dry ; in that case the ankle joint and the ligaments of the foot may be dissected whilst the other is being moistened.

Dissection
to see

Dissection.—For the preparation of the ligaments of each articulation, it is sufficient to detach the muscles and tendons from around it, and to remove the fibrous structure that may obscure or conceal the ligamentous bands.

a capsule
and the ex-
ternal liga-
ments.

In the knee joint a kind of capsule is to be defined around the articular surfaces of the bones ; and there are four other ligaments, anterior and posterior, internal and external, which are thickened bands at the respective parts of the articulation. Some tendons, namely, those of the biceps, popliteus, adductor magnus, and semimembranosus, are to be followed to their insertion, and a part of each is to be left.

Bones in the
knee joint.

THE ARTICULATION OF THE KNEE.—The knee is the largest hinge joint in the body, and is formed by the contiguous ends of the tibia and femur with the patella. The articular surfaces of the bones are covered with cartilage, and are maintained in apposition by the following ligaments.

A capsule surrounds the ends of the bones, and fills the intervals between the stronger special ligaments. The fascia lata is closely united with it. In front it receives accessory fibres from the vasti and crureus, and from the biceps and sartorius; and behind, from the tendon of the semimembranosus. It is connected with the interarticular cartilages, and the tendon of the popliteus muscle perforates it.

The *external lateral ligament* (fig. 110,²) is round and cord-like. It is attached to the outer condyle of the femur below the tendon of the gastrocnemius, and descends vertically between two pieces of the tendon of the biceps to the outer part of the head of the fibula. Beneath the ligament are the tendon of the popliteus, and the external lower articular vessels and nerve.

A second fasciculus, *short external lateral ligament*, is sometimes found behind the other.

The *tendon of the biceps* is inserted into the upper part of the head of the fibula by two processes, and from one of these there is a prolongation to the head of the tibia. The external lateral ligament passes between the pieces into which the tendon is split.

The *tendon of the popliteus* may be followed to the femur by dividing the external lateral and capsular ligaments. It arises from the fore and upper part of the oblong depression on the outer surface of the external condyle of the femur. In its course to the outside of the joint, it crosses the external semilunar cartilage and the upper tibio-peroneal articulation. When the joint is bent, the tendon lies in the hollow on the condyle.

The *tendon of the adductor magnus* is inserted into a tubercle on the inner surface of the internal condyle above the attachment of the internal lateral ligament.

The *internal lateral ligament* (fig. 111,³) is scarcely distinguishable from the capsule at its attachment to the condyle of the femur; but it is separate from the capsule opposite

Fig. 110.*



Capsule a thin covering.

External lateral ligament is small.

Occasional band.

Tendon of the biceps is divided.

Tendon of the popliteus is attached to outer condyle.

Adductor magnus.

Internal lateral ligament.

* External ligaments of the knee joint (Bourguery).—1. Anterior ligament. 2. External lateral ligament. 3. Interosseous ligament. 4. Part of the capsule.

attach-
ments;

the head of the tibia, and becoming thicker is fixed for about an inch into the inner surface of the tibia, below the level

Fig. 111.*

is joined by
semimem-
branosus.

Insertion of
the semi-
membrano-
sus.



of the ligamentum patellæ. The tendons of the sartorius, gracilis, and semitendinosus muscles lie over the ligament; and the tendon of the semimembranosus, and the internal lower articular vessels are beneath it. To the posterior edge some fibres of the tendon of the semimembranosus are added.

The tendon of the semimembranosus muscle is to be followed beneath the hinder part of the internal lateral ligament. It is inserted beneath the ligament into an impression at the back of the inner tuberosity of the head of the tibia, and sends some fibres to that band; it gives also one membranous prolongation to join the fascia covering the popliteus muscle, and another to the posterior ligament of the knee joint.

Between the tendon and the bone is a synovial bursa.

Posterior
ligament.

The *posterior ligament* (ligament of Winslow) is formed in great part by the fibres from the tendon of the semimembranosus, which are directed across the joint to the outer condyle, but a deeper set of fibres is continuous with the general capsule. Numerous apertures exist in it for the passage of vessels and nerves to the interior of the articulation.

Two sets of
fibres.

Anterior
ligament, or

tendon of
the exten-
sors.

The *anterior ligament* (ligamentum patellæ) or the tendon of insertion of the extensor muscles of the leg (fig. 111, ¹), is about two inches long, and is narrower in the middle than at the ends. Superiorly it is attached to the lower part of the patella and the depression on the inner surface; and inferiorly it is inserted into the tubercle of the head of the tibia, and an inch of the bone below it. The expansion of the vasti covers it; and a bursa intervenes between it and the top of the tubercle of the tibia (p. 692).

Open the
knee joint

Dissection.—To see the reflections of the synovial membrane raise the knee on blocks, and open the joint by an incision from the front to the back on each side above the patella. When the anterior part of the capsule with the

* External ligaments of the knee joint (Bourguery).—1. Tendon of the extensor muscle ending below at 2 in the ligament of the patella. 3. Internal lateral ligament. 4. Lateral part of the capsule.

patella is thrown down, a fold (mucous ligament) will be seen extending from the end of the femur to the front of the joint below the patella. On each side of the knee-pan is a similar fold (alar ligament) over some fat.

The limb is afterwards to be laid flat on the table and part of the posterior ligament is to be removed, to lay bare the crucial ligaments at the back of the joint; but the limb is to be replaced in the former position before the parts are learnt.

The *synovial membrane* lines the interior of the capsule, and is continued to the articular ends of the bones. Besides covering the capsule, it invests the interarticular cartilages, and sends a pouch between the tendon of the popliteus and the external cartilage and the head of the tibia: it is likewise reflected over the strong crucial ligaments at the back of the joint. On the front of the femur the sac of the membrane extends two inches above the articular surface.

In the centre of the joint is a fold of the synovial sac, the mucous ligament, which contains a small vessel and some fat, and extends from the interval between the condyles to the fat below the patella. On each side of the patella is another fold—alar ligament, which is continuous with the former below the patella.

Dissection.—The ligamentous structures within the capsule (see below) will be brought into view, whilst the limb is still in the same position, by throwing down the patella and its ligament, and clearing away the fat behind it. In this step the student must be careful of a small transverse band that connects anteriorly the interarticular cartilages. The remains of the capsule and the synovial membrane are finally to be cleared away from the crucial ligaments and the interarticular cartilages.

Ligaments within the capsule.—The remaining ligamentous structures, although within the capsule, are external to the sac of the synovial membrane which is reflected over them. They consist of the crucial ligaments in the middle line; and of two flat plates of fibro-cartilage, the interarticular or semilunar, on the head of the tibia.

The *crucial ligaments* (fig. 112) are two strong fibrous processes between the ends of the tibia and femur, which maintain in contact the bones. They cross one another somewhat like the legs of the letter X, from which circumstance they have received their name. One is anterior to the other at the attachment to the tibia.

a. The *anterior ligament* (⁶) is oblique in its direction, and

oblique ;
its attach-
ments ;

is smaller than the posterior. Inferiorly it is attached to the inner lip of the hollow in front of the spine of the tibia,

Fig. 112.*

posterior is
vertical.



close to the inner articular surface ; and superiorly it is inserted into the back part of the outer condyle of the femur, on the inner surface, and slightly into the interval between the condyles.

b. The *posterior ligament* (*7*) is almost vertical between the bones at the back of the joint. By the lower end it is fixed to the back of the depression behind the spine of the tibia, near the margin of the bone ; and by the upper extremity it is inserted into the fore part of the hollow between the condyles of the femur, and into the contiguous surface of the inner condyle.

Their use in The use of these ligaments in the movements of the joint, after the other ligaments have been cut through, should be studied.

slight
flexion and
extension.

When the joint is only slightly bent, the posterior ligament is stretched ; and when it is straightened again the anterior band is made tense. But in greater flexion and extension both ligaments will be called into play to keep the one articular surface on the other. Thus in extreme flexion the anterior band will be stretched after the posterior, because there is an attempt to separate the articular surfaces backwards at the same time. So in extreme extension the posterior comes into action after the anterior ligament, to prevent the femur being carried forwards.

In extreme
flexion and
extension.

In rotation.

In rotation inwards of the tibia the ligaments are crossed tightly, and the movement is arrested by the stretching of the anterior fasciculus ; but in rotation outwards of the bone the ligaments untwist, becoming almost parallel, so as to allow it to be turned back foremost.

In keeping
the bones
in a line.

As long as both ligaments are whole the femur cannot be dislodged from the tibia. If the anterior be cut the femur can be displaced backwards : and if the posterior is divided,

* Internal ligaments of the knee joint. — 6. Anterior crucial. 7. Posterior crucial ligament. 8. Internal semilunar. 9. External semilunar fibro-cartilage. 10. Transverse ligament. 11. Anterior ligament to the upper peroneo-tibial articulation.

whilst the other remains entire, the bone can be brought in front of the articular surface of the tibia.

The *interarticular* or *semilunar cartilages* (fig. 112) are two fibro-cartilaginous plates, which partly cover the articular surface of the tibia. Semilunar cartilages are two.

They are thickest at the outer margin, where they are united by fibres to the capsule; and are hollowed on the upper surface so as to assist in giving depth to the fossæ for the reception of the condyles of the femur. Inserted into the tibia at their extremities, they are coarsely fibrous at their attachments to the bone, like the crucial ligaments; and they become cartilaginous only where they lie between the articular surfaces. The synovial membrane is reflected over them.

They are provided with two accessory bands:—one is between them at the fore part; the other ascends from the outer disc to the inner condyle of the femur.

The *internal* cartilage (⁸) is ovoid in form, and is a segment of a larger circle than the external. In front it is attached by a pointed part to an impression close in front of the inner articular surface of the tibia, and in a line with the anterior margin of the head of the bone. At the back, where it is much wider, it is fixed to the inner lip of the hollow behind the spine of the tibia, between the attachment of the other cartilage and the posterior crucial ligament. Internal is semi-circular.

The *external* cartilage (⁹) is nearly circular in form, and is connected to the bone within the points of attachment of its fellow. Its anterior part is fixed to the bottom of the depression in front of the spine of the tibia, and close to that process of bone; and its posterior extremity is inserted between the two osseous points of the spine. From the posterior part of this disc a ligamentous fasciculus ascends to the inner condyle of the femur, to be inserted before or behind the posterior crucial ligament. This fibro-cartilage is less closely united to the capsule than the internal, for the tendon of the popliteus muscle separates it behind from that membrane. External, nearly circular in form, has a band of ligament.

The *transverse ligament* is a narrow band of fibres between the semilunar cartilages at the front of the joint. Sometimes it is scarcely perceptible. Transverse ligament.

Articular surface of the bones.—The lower end of the femur presents on each side a large convex condyle, with a slightly hollowed part between. The articular surface on the external condyle extends highest and is the widest. Each condyloid half of the bone has the following differences in its surface. Altogether in front is a trochlea or pulley- Articular end of the femur,

- like surface formed by both : at the posterior part each is rounded and convex, but the inner one most so ; whilst the intervening part of each is flattened.
- of the tibia, On the head of the tibia are two articular surfaces, but the inner one is deepest, and has the greatest extent.
- and of the patella. The surface of the patella is divided into two parts, but unequally, by a vertical ridge, so that the outer, which corresponds with the wider face on the external condyle of the femur, is the largest.
- Articulation of tibia and fibula. PERONEO-TIBIAL ARTICULATIONS.—The tibia and fibula are united by ligamentous bands at the extremities, where they touch ; and by an interosseous ligament between the shafts of the bones.
- Dissection of the ligaments. *Dissection.*—The muscles are to be taken away from the front and the back of the interosseous ligament ; and the loose tissue is to be removed from a small band in front of, and behind both the upper and lower articulations between the tibia and fibula.
- Upper articulation, The UPPER ARTICULATION, like the lower, is almost immovable, and therefore the structures between the ends of the bones are slight and simple. Only two small bands, anterior and posterior, are present.
- by anterior The *anterior ligament* extends over the joint from the outer tuberosity of the tibia to the head of the fibula. The
- and posterior band. *posterior* ligament, thinner than the anterior, is attached to corresponding parts of the bones behind the joint, and is covered by the tendon of the popliteus muscle.
- Synovial sac. The articular surfaces are covered with cartilage ; and a *synovial membrane* lines the articulation, projecting upwards so as to touch that of the knee joint.
- Lower articulation has The LOWER ARTICULATION possesses an anterior and a posterior band, together with an inferior ligament between the ends of the bones.
- anterior, The *anterior ligament* reaches obliquely from the lower end of the tibia to that of the fibula ; and the *posterior* has
- posterior, attachments behind the joint similar to those of the band in front.
- and inferior ligament. The *inferior ligament* closes the space between the contiguous ends of the tibia and fibula, and consists of transverse yellowish fibres. It is distinct from the posterior ligament, and is fixed on one side to the end of the fibula above the pit ; and on the other it is inserted into the contiguous surface of the tibia, as well as into part of the posterior edge of the articular surface, so as to assist in deepening the hollow into which the astragalus is received.

The *interosseous ligament* is an aponeurotic partition between the muscles on the front and back of the leg. Its fibres are directed downwards for the most part from the outer border of the tibia to the ridge on the anterior or inner surface of the fibula : but some few cross in the opposite direction. Both superiorly and inferiorly is an aperture which transmits vessels, viz. the anterior tibial at the one spot, and the anterior peroneal at the other.

Interosseous
ligament be-
tween the
bones.

Some strong irregular bundles of fibres, which constitute the *inferior interosseous ligament*, extend between the bones below the aperture for the anterior peroneal artery : these take different directions, like the fibres of the rest of the interosseous membrane. It may be seen after the examination of the ankle joint by separating or sawing longitudinally the lower ends of the bones.

Inferior
ligament.

ARTICULATION OF THE ANKLE.—Like the knee the ankle is a ginglymoid or hinge joint. In this joint the upper surface of the astragalus is received into an arch formed by the lower ends of the tibia and fibula, and the four ligaments belonging to this kind of articulation connect together the bones.

Bones in
the ankle
joint.

Dissection.—To make the dissection required for the ligaments of the ankle joint, the fibrous tissue and vessels must be removed from the front and back of the articulation. For the purpose of defining the lateral ligaments, the limb must be placed first on one side and then on the other. The internal ligament is wide and strong, and is beneath the tendon of the tibialis posticus. The external is divided into three separate pieces ; and to find these the peronei muscles, and the remains of the annular ligament below the outer malleolus, should be taken away.

Dissection
of the
ankle joint.

The *anterior* or tibio-tarsal ligament is a thin fibrous membrane, which is attached to the tibia close to the articular surface, and to the upper part of the astragalus near the articulation with the scaphoid bone. The ligament is not usually a continuous membrane, for in it are some rounded intervals and apertures for vessels. On the sides it joins the lateral ligaments.

Anterior
ligament is
thin and
imperfect.

The *posterior* ligament is thinner internally than externally ; and it is inserted into the tibia and the astragalus, close to the articular surfaces of the bones. Towards the outer part is a bundle of transverse fibres which is attached to the hollow on the inner surface of the external malleolus.

Posterior
ligament.

The *internal lateral* or deltoid ligament (fig. 113) is attached by its upper or pointed part to the inner malleolus,

Internal or
deltoid ;

attach-
ments.

and by its base to the astragalus, the os calcis, and the scaphoid bone. From its upper attachment the fibres

Fig. 113.*



radiate to their insertion below in this manner;—The posterior (¹) are directed to the hinder part of the inner surface of the astragalus; the middle (²) pass vertically to the side of the sustentaculum tali of the os calcis; and the anterior (³), which are thin and oblique, join the inferior calcaneo-scaphoid ligament and the inner side of the scaphoid bone. The tendons of the tibialis posticus and flexor longus digitorum are in contact with this ligament.

External
has three
parts;

anterior,

middle,

and pos-
terior.

The *external lateral ligament* (fig. 114) consists of three separate pieces, anterior, middle, and posterior: two of these (anterior and posterior) are attached to the astragalus, and the other to the os calcis. The *anterior* piece (¹) is a short flat band, which is directed from the fore part of the malleolus to the part of the astragalus in front of the lateral articular surface. The *middle* portion (²) is flattened, and descends from the tip of the malleolus to the outer surface of the os calcis, about the middle. The *posterior* part (³) is the strongest, and is almost horizontal in direction; it is

* Internal lateral ligament of the ankle (altered from Bourgery).
—1. Posterior piece. 2. Middle piece. 3. Anterior piece of the inner ligament. 4. Inferior calcaneo-scaphoid ligament.

connected externally to the pit on the inner surface of the malleolus, and is inserted into the posterior part of the

Fig. 114.*



astragalus behind the articular surface, extending to the groove for the flexor proprius pollicis tendon.

The posterior and middle fasciculi are in contact with the peronei muscles. The middle part is but slightly in contact above with the synovial membrane of the ankle joint; and both it and the posterior piece touch the synovial membrane between the astragalus and the os calcis.

Dissection.—Dividing the ligaments of the ankle joint, separate the astragalus from the bones of the leg, to see the osseous surfaces entering into the joint.

Articular surfaces.—On the tibia there are two articular faces, one of which corresponds with the end of its shaft, and the other with the malleolus; but on the fibula only the surface of the malleolus which is turned to the astragalus, is tipped with cartilage. The astragalus has a central articular surface, which touches the end of the tibia: and on the sides are articular impressions for contact with the malleoli, but the outer one is the largest.

* External lateral ligament of the ankle (altered from Bourguery).
—1. Anterior part. 2. Posterior part. 3. Middle part of the outer ligament. 4. Interosseous of astragalus and os calcis. 5. External calcaneo-scapoid ligament.

- Synovial sac.** The *synovial membrane* of the joint lines the capsule, and sends a process upwards for a very short distance between the tibia and fibula.
- Articulations of the tarsus.** **ARTICULATIONS OF THE ASTRAGALUS AND OS CALCIS.**—These two chief bones of the tarsus are united to one another, as well as to the bones in front of them, by separate articulations.
- Dissection for the joints of the tarsus.** *Dissection.*—All the joints of the foot will be demonstrated by removing from both the dorsum and the sole the parts that have been already examined, and then cleaning the ligaments. Between the different tarsal bones bands of ligament extend, which will be defined by removing the areolar tissue from the intervals between them (fig. 116).
- Astragalus with os calcis by posterior, external, and interosseous ligament.** **THE ASTRAGALUS WITH THE OS CALCIS.**—These bones are kept together by a strong interosseous ligament; and there is also a thin band on both the outer side and behind.
- The *posterior ligament* consists of a few fibres between the bones, where they are grooved by the tendon of the flexor pollicis; and the *external ligament* is connected to the sides of the astragalus and os calcis, near the middle piece of the external lateral ligament of the ankle joint.
- The *interosseous ligament* consists of strong vertical and oblique fibres, which are attached above and below to the depressions on the contiguous surfaces of the two bones. This band extends across the bones, and its depth is greatest at the outer side.
- Articular surfaces and synovial membranes.** When the astragalus is removed subsequently, articular surfaces with synovial sacs will be seen between the bones. There are *articular surfaces* where the bones touch, viz. one behind the interosseous ligament, and one or two in front of it. Two *synovial membranes* exist between the bones, one for each articulation; and the one in front of the interosseous ligament is continued between the head of the astragalus and the scaphoid bone.
- Astragalus with scaphoid bone.** **THE ASTRAGALUS WITH THE SCAPHOID BONE.**—The large head of the astragalus is received into the hollow of the scaphoid bone, and is united to it only by a dorsal ligament; for the place of plantar and lateral ligaments is supplied by strong bands between the os calcis and the scaphoid bone, which will be noticed below.
- Dorsal ligament.** The *dorsal* or *astragalo-scaphoid ligament* (fig. 116) is attached to the astragalus close to the articulation, and to the dorsal surface of the scaphoid bone: its attachments will be better seen when it is cut through. The *synovial*
- Synovial membrane.** *membrane* of the joint is the same as that for the articu-

lation between the astragalus and the anterior part of the os calcis.

THE OS CALCIS WITH THE SCAPHOID BONE.—These bones are not in contact, but ligamentous bands extend between them both below and on the outer side of the head of the astragalus, which serve as inferior and lateral ligaments to the astragalo-scaphoid articulation, and make more complete the socket for the reception of the fore part of the astragalus.

The *inferior ligament* (calcaneo-scaphoid) will be defined in the sole of the foot by removing some fibro-cartilaginous substance from it (fig. 113, ⁴); and its upper surface, together with the outer ligament, will be brought into view by sawing off the part of the astragalus in front of the interosseous ligament. It is attached by one extremity to the fore part of the sustentaculum tali of the os calcis, and by the other to a groove on the under surface of the scaphoid bone. In the upright posture of the body the tendon of the tibialis posticus is beneath the ligament in the sole of the foot, and on it the head of the astragalus rests.

The *external calcaneo-scaphoid* (fig. 114, ⁵) is placed outside the head of the astragalus, and serves as a lateral ligament to the astragalo-scaphoid articulation; it is about three quarters of an inch deep, except at the centre, where it is narrowed. Behind, it is fixed to the fore part of the os calcis, between the articular surfaces for the cuboid bone and astragalus; and in front it is attached to the outer side of the os scaphoides.

THE OS CALCIS WITH THE CUBOID BONE.—The ligaments in this articulation are plantar and dorsal, the former being much the strongest; and there is also an internal or interosseous band.

The *dorsal ligament* (superior calcaneo-cuboid) is a thin fasciculus of fibres (fig. 116), which is attached to the upper surfaces of the contiguous ends of the os calcis and the cuboid bone; it may be divided into two parts.

At the inner side of the os cuboides is a rather strong *internal or interosseous band* from the os calcis: this is attached behind to the upper part of the os calcis, external to the outer band to the scaphoid bone; and in front it joins the contiguous inner part of the os cuboides.

The *inferior calcaneo-cuboid ligament* in the sole of the foot (fig. 115) is the strongest, and is divided into a superficial and deep part:—The superficial portion, named *ligamentum longum plantæ* (¹), is attached to the under surface

The last is strongest, and divided into two parts.

of the os calcis from near the tuberosities to the tubercle in front, and its fibres pass forwards to be connected with the ridge on the under part of the cuboid bone ; but some of the inner fibres are prolonged over the tendon of the peroneus longus muscle, assisting to form its sheath, and are attached to the bases of the third and fourth metatarsal bones. The deep piece of the ligament (²) will be seen, on division of the superficial, to extend from the tubercle and the pit in front of it on the fore part of the under surface of the os calcis, to the portion of the cuboid bone internal to the ridge.

Fig. 115.*



Synovial sac.
Dissection.

A simple *synovial membrane* belongs to the articulation.

Dissection.—The interosseous ligament uniting the astragalus and the os calcis is now to be cut through, to demonstrate the articular surfaces, the synovial sacs, and the attachment of the ligament.

Union of the scaphoid bone

ARTICULATIONS OF THE SCAPHOID BONE.—The scaphoid bone articulates in front with the three cuneiform bones, and laterally with the os cuboides, by dorsal and plantar bands.

to the cuneiform.

In the *articulation* with the *cuneiform bones* there are three small *dorsal ligaments*, one to each bone, but the innermost is the strongest. The place of *plantar bands* is supplied by processes of the tendon of the tibialis posticus.

Synovial sac,

A *synovial membrane* lines the articulation, and sends forwards prolongations between the cuneiform bones.

To the cuboid bone.

In the *articulation* with the *os cuboides* there is a *dorsal oblique band* of fibres between the contiguous surfaces of the bones ; a *plantar transverse band*, which is concealed by the tendon of the tibialis posticus ; and a strong *interosseous ligament*.

Synovial sac sometimes.

When the bones touch, the surfaces are tipped with cartilage, and are furnished with a prolongation from the common *synovial membrane* of the tarsus.

* Plantar ligaments of the foot (Bourguery and Jacob).—1. Deep plantar ligament. 2. Deep portion of the inferior calcaneo-cuboid ligament. 3. Tendon of the peroneus longus muscle.

ARTICULATIONS OF THE CUNEIFORM BONES (fig. 116).— Union of the cuneiform bones
These bones are united to one another by cross bands, and the external one articulates with the os cuboides after a similar manner.

The three *cuneiform bones* are connected together by short transverse *dorsal* bands between the upper surfaces. Similar *plantar* ligaments are wanting, except between the two innermost. There are also *interosseous* ligaments between the contiguous surfaces of the bones.

Where the external cuneiform touches the cuboid bone the surfaces are covered with cartilage, and are furnished with either a prolongation of the common tarsal synovial membrane, or a distinct synovial sac. A *dorsal* ligament passes transversely between the two, and a *plantar* ligament takes a similar direction. Between the bones there is also an *interosseous* ligament.

The *synovial membrane* of the articulations of the cuneiform bones is common to many of the bones of the tarsus. Placed between the scaphoid and the three cuneiform bones, it sends one prolongation forwards between the inner two cuneiforms to the joints of the second and third metatarsal bones; another outwards to the articulation of the scaphoid with the cuboid bone; and sometimes a third to the joint between the external cuneiform and the os cuboides.

ARTICULATION OF THE METATARSAL BONES.—The bases of the metatarsal bones, except the first, are connected together by dorsal, plantar, and interosseous ligaments; and where their contiguous parts touch, they are covered with cartilage, and have offsets of a synovial sac.

The *dorsal ligaments* (fig. 116) are small transverse bands *dorsal*, from the base of one metatarsal bone to the next, for the four outer toes. The *plantar* ligaments are similar to the *plantar*, dorsal (fig. 115). The *interosseous* ligaments are short,

Fig. 116.*



and with the cuboid bone.

Synovial sac.

* The several ligamentous bands uniting the bones of the foot on the dorsal aspect are here delineated (Bourgery and Jacob).

and interosseous ligaments. transverse fibres between the contiguous rough lateral surfaces, and they may be afterwards seen by forcibly separating the bones.

Lateral union. *Lateral union.*—The four outer bones touch one another laterally, and the second lies against the internal cuneiform. The surfaces in contact are covered with cartilage; and the joints are provided with synovial membrane, which is derived from the sacs serving for the articulation of those metatarsal with the tarsal bones.

Synovial sacs. The metatarsal bone of the great toe, like that of the thumb, is not united to the others by any intervening bands: it has its own joint with the internal cuneiform bone.

Articulation of great toe. The digital ends of all the metatarsal bones are further united by the *transverse metatarsal ligament*; this has been described in page 745.

Anterior ligament. **ARTICULATIONS OF THE TARSAL AND METATARSAL BONES.**—The last row of the tarsus articulates with the metatarsus, the three cuneiform touching the three inner metatarsal, and the os cuboides carrying the outer two metatarsal bones. The bones are tipped with cartilage where they are in contact, and have longitudinal and oblique dorsal, plantar, and lateral ligaments.

Articulation of the tarsus and metatarsus. The *dorsal ligaments* (fig. 116) are thin bands of fibres, which are either longitudinal or oblique as they extend from the tarsal to the metatarsal bones. Each metatarsal bone receives one ligament, except that of the second toe, to which there are three:—the first has its band from the inner cuneiform bone; the three fasciculi to the second come from all the cuneiform bones, one from each; the third bone has a ligament from the external cuneiform; and the fourth and fifth have a fasciculus to each from the os cuboides.

Dorsal ligaments. *Plantar ligaments.*—There is one *longitudinal band* from each cuneiform to its corresponding metatarsal bone; but between the cuboid and its metatarsal bones there are only some scattered fibres.

Plantar are longitudinal and oblique. *Oblique plantar ligaments.*—A fasciculus of fibres extends from the front of the internal cuneiform to the second and third metatarsal bones; and from the external cuneiform there is a band to the metatarsal bone of the little toe.

Lateral ligaments. The *lateral ligaments* are longitudinal; they lie deeply between the bones, and are connected with the second and third metatarsal: they will be better seen by partly cutting the transverse bands joining the bases of the bones. To the bone of the second toe there are two, one on each side;—the inner is strong and attached to the internal cuneiform, and

the outer is fixed into the middle or the outer cuneiform bone. The metatarsal bone of the third toe is also provided with two lateral bands: of these the outer is inserted into the external cuneiform, and the inner into the middle cuneiform bone.*

Line of the articulation.—The line of the articulation between the tarsus and metatarsus is zigzag, in consequence of the unequal lengths of the cuneiform bones. To open the articulation the knife should be carried obliquely forwards from the tuberosity of the fifth to the base of the second metatarsal bone; then about two lines further back for the union of the second metatarsal with the middle cuneiform; and lastly, half an inch in front of the last articulation for the joint of the internal cuneiform with the first metatarsal bone.

Line of the articulation across the foot.

The *synovial membranes* in the tarso-metatarsal articulation are two or three in number. There is one between the internal cuneiform and its metatarsal bone. A second is between the cuboid and the two outer metatarsals, and serves for the adjacent lateral articular surfaces of the bones: this is not always separate from the following. The third is placed in the joint between the middle and external cuneiform with their metatarsal bones (second and third), and is an offset of the common synovial membrane belonging to the articulation of the scaphoid with the cuneiform bones (p. 770): prolongations from it are furnished to the lateral articular parts of the second, third, and fourth (inner side) metatarsals.

Three synovial membranes.

Dissection.—All the superficial ligaments having been taken away, the interosseous ligaments may be seen by separating forcibly the cuneiform bones from one another and from the os cuboides; the latter bone from the os scaphoides; and the bases of the metatarsals from one another. The dissector will find that in using force, the bones will tear sometimes sooner than the ligaments.

Separate the bones to see interosseous ligaments.

ARTICULATION OF THE METATARSUS AND PHALANGES.—These are ball-and-socket joints, in which the head of the metatarsal bone is received into the cup-shaped cavity of the phalanx.

Union of metatarsus and phalanges, by

Each articulation has two *lateral* and an *inferior ligament*, as in the hand, and the joint is further strengthened above by an expansion derived from the tendon of the short ex-

two lateral ligaments, and inferior.

* Three of these ligamentous bands are most commonly present, viz., two to the second toe, and one to the outer side of the third toe: the ligaments inserted into the contiguous surfaces of the middle and external cuneiform bones may be wanting.

Synovial
sac.

tensor of the toes. A distinct *synovial membrane* exists in each joint.

In the articulation of the great toe there are two sesamoid bones, which are connected with the inferior and lateral ligaments.

See the
hand.

All these structures are better seen in the hand, where they are more distinct; and their anatomy is more fully described with the dissection of that part. (See p. 347.)

Union of the
phalanges
same as be-
fore de-
scribed in
the hand.

ARTICULATIONS OF THE PHALANGES.—There are two phalangeal joints to each toe, except the first.

Ligaments similar to those in the metatarso-phalangeal joints, viz., two *lateral* and an *inferior*, are to be recognised in these articulations. The joint between the last two phalanges is least distinct; and oftentimes the small bones are immoveably united by osseous substance.

Synovial sac.

A simple *synovial membrane* exists in each phalangeal articulation.

These ligaments receive a more particular notice with the dissection of the hand (p. 348).

ARTERIES OF THE LOWER LIMB.

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TABLE OF THE ARTERIES OF THE LOWER LIMB.

The Femoral Artery gives off	External pudic . .	{ Superior inferior.			
	superficial epigastric				
	superficial circumflex iliac.				
	Profunda . .	External circumflex	{ Ascending descending transverse.		
		internal circumflex .	{ Muscular articular ascending transverse	{ End branches.	
		first perforating			
		second perforating .	nutritious.		
	Muscular	third perforating			
		terminal branch.			
	Anastomotic	Superficial			
		deep branch.			
	Popliteal . .	Muscular			
		upper internal			
		upper external articular			
		lower internal			
		lower external articular			
		azygos articular			
		sural,			
		Anterior tibial . .	Recurrent cutaneous		
			muscular		
			internal malleolar		
			external malleolar		
		Posterior tibial . .	articular		
			tarsal		
			metatarsal . .	{ three interosseous.	
		Peroneal . . .	first interosseous communicating to deep arch		
			digital. . . .	{ To great toe and half the next.	
		Internal plantar	Muscular nutritious to fibula		
			anterior peroneal.		
			nutritious to tibia communicating to peroneal .		
			articular		
		External plantar			
			{ Muscular		
		plantar arch.			
			{ Muscular posterior perforating digital, for the toes and a h anterior perforating.		

N.B. The branches of the internal iliac artery that end in the limb, will be found in the table the arteries of the abdomen.



CHAPTER X.

DISSECTION OF THE EYE.

- Situation of the eyeball.** THE eyeball is the organ of vision. It is lodged in the orbit ; and supported in this hollow on a mass of fat, it is surrounded by muscles which impart movement to it. Two lids or shields protect the eyeball from external injury, and moderate the quantity of light admitted into the interior ; and the anterior or exposed surface is covered by a mucous membrane (conjunctiva).
- Parts around and in front of it.** *Directions.*—In the absence of specimens of the human eye, the structure must be learnt on the eye of some large animal, as the ox for example. Let the student, therefore, procure half a dozen or more eyes of the ox for the purpose of dissection. One or two shallow basins will be needed, and in the bottom of one of them, or of a deep plate, there ought to be some wax or tallow.
- The dissection to be made on the eye of the ox.** *Dissection.*—To see the general form of the ball of the eye, and the outer surface of the external coat, the attachment of the different muscles should be taken away ; and the loose mucous membrane should be removed also from around the anterior part.
- Detach the muscles.** The *ball of the eye* is roundish in form, and consists of two parts, which differ greatly in appearance, viz., an opaque posterior portion, forming four fifths of the whole, and a smaller transparent portion (cornea) in front ; these are segments of different-sized spheres, and the anterior part belongs to the smaller sphere. To the back of the globe the optic nerve is attached, rather to the inner side of the axis of the ball ; and around it the nutritive vessels and the nerves are disposed. The antero-posterior diameter of the ball amounts to about an inch, and exceeds the transverse by about a line.
- Form of the ball.** The organ of vision is composed of certain delicate central parts, and of others requisite for their protection and support. Its fundamental constituent is an expansion of the optic nerve (retina). Within the nervous layer are central transparent
- Position of optic nerve.**
- Diameter.**
- Outline of the constituents of the organ of vision.**

parts to bring the rays of light to a focus on it ; and in front of these is a moveable curtain (iris), to regulate the admission of light into the interior. To defend such delicate structures, certain denser strata are arranged around them ; and to absorb the superabundant rays of light entering the eyeball, one of them is provided with dark pigment.

The coats of the eyeball, forming three strata, are arranged one within another, and are named sclerotic, choroid, and retina. The transparent media in the interior are likewise three, viz., the lens, the aqueous humour, and the vitreous body.

Dissection.—To obtain a general idea of the structures to be dissected, the student may destroy one eyeball for that purpose by cutting through it circularly : he will be then able to recognise generally the arrangement of the parts mentioned above, and their strength and appearance ; and will be better prepared to follow the directions that are afterwards given.

FIBROUS COAT OF THE EYEBALL.—The outer casing of the eye consists of an opaque hinder part called sclerotic, and of an anterior transparent part or cornea.

The **SCLEROTIC COAT** (*cornea opaca*) is the firm, whitish, and opaque part of the external stratum of the eyeball, which supports the more delicate structures within.

Dissection.—To examine the inner and outer surfaces of this coat, and of the cornea, it will be necessary to cut circularly with a blunt-pointed scissors through the sclerotic or outer coat a quarter of an inch from the cornea ; and next to separate the cornea from the front of the eyeball, by breaking through a structure that fixes it slightly. In raising the cornea, the student may observe the aqueous fluid escape from the containing chamber. The other structures may be then removed from the interior of the sclerotic covering ; and the central parts of the ball may be set aside for subsequent use.

The *sclerotic tunic* of the eye is bell-shaped, and extends from the entrance of the optic nerve to the margin of the cornea, forming about five sixths of the ball.

At its posterior part and a little to the inner side of the centre (one tenth of an inch), the optic nerve is transmitted through an aperture in it : this opening decreases in size from without inwards, and is cribriform when the nerve is drawn out—the lattice-like condition being due to the union with its margin of the bundles of fibrous tissue between the funiculi of the nerve. Other smaller apertures for the passage

Number of coats and central parts.

Dissection.

Fibrous coat.

Sclerotic part.

Dissection to see the interior.

Form and extent.

Apertures behind.

Ending in front.

Outer and inner surface.

Thickness.

Formed of white and

of the nutritive vessels and nerves are situate around that for the optic nerve. In front it is continuous with the transparent cornea.

On the outer surface this coat is smooth, except where the muscles are attached : but on the inner aspect it is covered with flocculi, and with the ends of ruptured vessels and nerves, and is of a dark colour.

The sclerotic covering is thickest at the back of the eyeball, but it becomes thinner and whiter towards the cornea, where it is visible as the "white of the eye." Where it joins the cornea it becomes again somewhat thickened.

Structure.—The sclerotic coat is formed of layers of white

Fig. 117.*



yellow fibrous tissue.

fibrous tissue, mixed with a fine network of yellow or elastic fibres, which possess thickenings at intervals corresponding

* Enlarged vertical section of the eyeball, representing the parts near the union of the sclerotic coat and the cornea (Köl liker).—*s.* Sclerotic.—*c.* Cornea. *l.* Lens. *1* *. Posterior layer of the cornea. *1.* Iris. *2.* Pillars of the iris. *3.* Posterior pigmentary layer of the iris.—*Pr. cil.* Ciliary process. *4.* Layer of cells on the inner surface of the process, continuous behind with the retina. *10.* Ciliary muscle outside the processes. *7-8.* Anterior and posterior layers of the capsule of the lens. *5.* Suspensory ligament of the lens. *6.* Canal of Petit. *9.* Hyaloid membrane, blending with the hinder part of the lens capsule.

with the position of the primitive formative cells. Though interlaced with one another (fig. 117, c), the fibres have rather a longitudinal direction towards the back of the ball, and a transverse one at the outer surface near the cornea. Only a few vessels ramify in the membrane. The existence of nerves in it is doubtful.

Vessels and nerves.

CORNEA.—This firm transparent membrane (*cornea pellucida*) fits into the front of the eyeball, of which it forms about one sixth. Its shape is circular, though, when viewed in front, particularly in the ox, it appears largest in the transverse direction in consequence of the opaque sclerotic structure reaching further on it above and below than on the sides. It is smooth and soft to the touch, is convex anteriorly, but concave posteriorly, and is of equal thickness throughout. Its anterior is of rather less extent than its posterior surface. At the circumference it is blended with the sclerotic coat by continuity of tissue; and it measures about half an inch transversely, but rather less from above down.

Cornea:

extent and form.

Curve.

Surface.

Size.

This clear and diaphanous structure, resembling in appearance the glass of a watch, bounds the anterior chamber of the eyeball, and gives passage to the rays of light entering the organ. When the cornea is supported by the aqueous humour, it deflects the rays of light transmitted to the eye, and thus influences by its greater or smaller convexity the different degrees of sight at a distance. After death it becomes flaccid from the transudation of the aqueous humour; or if it is immersed in water it is rendered opaque by infiltration of the tissue by that fluid.

Situation in front of the sclerotic.

Its action on the rays of light.

Structure (fig. 118, A).—The cornea is laminar in texture. It is constructed of a special, thick part called *cornea proper*; in front of this is a thin elastic layer with an epithelial stratum; and behind it is another fine elastic membrane covered by an epithelium. The two structures in front of the proper cornea constitute the conjunctiva: and the two behind form the membrane of Demours.

Composed of layers.

In the healthy condition *bloodvessels* do not permeate its structure, but cease in capillary loops at the circumference. *Nerves* ramify in it in great abundance (Schlemm).

Has not blood-vessels.

Nerves.

The *cornea proper* (lamellated cornea) is made up of a series of superposed layers, about sixty in number in a section at a given spot, which join one another at numerous points, and cannot therefore be detached for any distance.*

Cornea proper is formed of layers.

* The facts stated in the description in this and in many other places,

with inter-
vals be-
tween.

This structure possesses great toughness; and its transparency depends upon the parallelism of the different strata, and their distance from one another

being duly maintained, for if they are disarranged by compression or other means, the translucency is destroyed. The laminae of the cornea are formed of fibrous tissue, continuous with that of the sclerotic coat, and containing ramified nucleated corpuscles, but here flattened into membranous layers, and arranged one over another. The tissue when boiled gives chondrin.

The membrane at the back of the cornea (fig. 118)—*membrane of Demours*—consists of a basement layer (posterior elastic lamina, Bowman) covered by epithelium.

The *posterior elastic layer* (d) may be peeled off after a cut has been made across the cornea. It is a thin, but dense and hard membrane, $\frac{1}{2000}$ th to $\frac{1}{1000}$ th of an inch in thickness, which tears readily when an attempt is made to detach it, and curls up with the attached surface innermost when it

characters : is separated. It is always transparent, and remains so after boiling, after the action of acids, and even after maceration. At the edge of the cornea this lamina breaks up into processes ("pillars of the iris") which turn backwards, and become blended with the outer margin of the iris, and with the choroid and sclerotic coats. Though very elastic, this membrane is apparently without a definite structure. A laminar *epithelium*, like that on serous membranes, clothes its free surface.

are obtained from Mr. Bowman's "Lectures on the Eye," and from the "Physiological Anatomy," part third, 1847, of Dr. Todd and Mr. Bowman.

* Vertical section A of the cornea.—b. Anterior elastic layer with the conjunctival epithelium on it. c. Oblique fibres from it to the layers of the cornea. d. Posterior elastic lamina: e. Epithelium on it (membrane of Demours). B. Surface view, and c. side view of the epithelium of the membrane of Demours.

Fig. 118.*



The *conjunctiva* in front of the cornea (fig. 118) has also a basement layer (anterior elastic lamina, Bowman), with an epithelial covering in front.

Layer in front of cornea.

The *anterior elastic layer* (b) is a transparent structure, similar in its properties to the posterior, but thicker than it (from $\frac{1}{2000}$ th to $\frac{1}{1200}$ th of an inch), which extends over the front of the cornea, and seems to be the basement membrane of the conjunctiva. From its posterior surface fine shreds (c) are continued into the cornea proper. The *epithelium* is formed of three or four layers of scales, the deeper being columnar, but the superficial laminar in form.

Anterior elastic layer is part of conjunctiva;

has an epithelium.

VASCULAR COAT OF THE EYEBALL.—The next covering (fig. 121) is situate within the sclerotic, and is formed chiefly of bloodvessels and pigment cells. Its strength is but slight, and it is lined by a pigmentary membrane. It may be divided into three parts;—a posterior (choroid) corresponding with the sclerotic; an anterior (iris) opposite the cornea; and an intermediate ring (ciliary ligament and muscle) on a level with the union of the sclerotic and cornea.

Choroid coat is vascular.

Components.

Dissection.—Supposing the sclerotic coat of an eye cut through circularly near the anterior part, as before directed (p. 779), it will be necessary, in order that the choroid coat may be laid bare, to take away the rest of the sclerotic. The outer coat is to be removed in water, and two or more incisions are to be directed backwards in it from the circular cut to the optic nerve. In removing the flaps some slight connections are to be broken through, but the slender vessels and nerves are to be preserved. The white ring around the eye in front, which comes into view during the dissection, is the ciliary muscle which limits the extent forwards of the black choroid coat.

Dissection to see the choroid coat.

For the purpose of seeing the ciliary processes inside the anterior termination of the choroid coat, let the sclerotic covering be divided, and the cornea removed on another eyeball as before; and after making two or three cuts in the sclerotic towards the optic nerve, the resulting flaps should be pinned to the wax in the plate, so as to support the eye in an upright position. To obtain an anterior view of the processes, proceed to remove with care the iris, taking it away from the white ring of the ciliary muscle and ligament, and from the ciliary processes beneath, so as to leave these undisturbed and displayed.

To see the ciliary processes

by an anterior

On another ball, in which the fore part of the choroid is shown by removing the sclerotic as above directed, a posterior view of the processes is to be prepared. In this

and a posterior view.

dissection the iris is to be left untouched, but the choroid coat is to be divided around with a scissors a little behind the ring of the ciliary muscle, and is to be taken away with that ligament and the attached iris in one piece. By gently washing the pigment from the back of the iris the small processes will be made manifest. By means of this dissection the interior of the choroid coat may be seen.

To see the interior,

and the structure.

To make a vertical section.

The structure of the membrane may be examined on a fragment obtained from the eye destroyed in making the preparation of the sclerotic coat.

If a vertical section is made of another eyeball, it will show the ciliary processes in their natural position, and will demonstrate the relative situation of all the parts. This section, which it is difficult to make, should be attempted in water with a sharp, large knife, and on a surface of wax or wood, after the sclerotic coat has been cut with a scissors. When the eye has been divided, the halves should remain in water.

Form and extent.

Anterior termination.

The CHOROID COAT (fig. 121) is a thin membrane of a dark colour, and forms a segment of a sphere. Like the sclerotic stratum, it extends from the optic nerve to the fore part of the eyeball. When viewed on the eye in which the ciliary ligament is entire, it appears to end at the ligament; but it may be seen in the other dissections to bend inwards behind that ring, and to end in a series of folds or processes (*pars plicata*) behind the iris.

Opening.

Outer surface rough;

inner smooth.

Ciliary processes.

Position.

This covering is thicker and stronger behind than in front. It is supported at the bottom of the eyeball by its close connection to the sclerotic coat, and in front by the ciliary ligament. Posteriorly it is pierced by a round aperture for the passage of the optic nerve; and anteriorly it is united with the ciliary ligament and iris.

The outer surface is flocculent, and is covered by the remnants of a pigmentary areolar tissue (*membrana fusca*) between it and the sclerotic coat: on it may be seen small veins (*f*) arranged in parallel arches as they open into larger trunks, and lying on its surface are the ciliary arteries and nerves (*e*). The inner surface is smooth, and is lined by a thin pigmentary epithelial layer (*membrana pigmenti*), though in the eye of the ox it shines through that layer with a metallic lustre.

The *ciliary processes* (fig. 119, ³) or the plaits in front on the inner surface of the choroidal coat, are arranged around the lens, like the many petals of a flower, forming a circle (*corpus ciliare*). These processes, about 85 in number, lie

side by side, and consist of larger and smaller folds, but the differently sized pieces do not alternate regularly. At their inner extremities they are united by loops or transverse ridges.

The plaits are thin externally at the commencement, but increase in depth internally, becoming convex, and project inwards around the lens. By their free ends they bound circumferentially the space (posterior chamber) behind the iris. Internally or beneath, the ciliary processes are closely connected with the membrane (suspensory ligament) on the front of the vitreous humour, and fit into hollows between eminences on the anterior surface of that membrane. In front or externally they correspond with the back of the iris, but are separated from it by pigment.

Structure.—The choroid coat and its ciliary processes are formed principally of bloodvessels, whose branches are so arranged as to form an outer and an inner layer. Ramified pigment cells make up the rest of the coat.

In the outer layer (fig. 121) the larger branches of both arteries and veins are contained, and the veins (*f*) form parallel curves (*vasa vorticosa*) as they end in four or five chief efferent trunks. In the interspaces of the vessels towards the outer surface there are ramified irregular pigment cells (fig. 120, *A*), which contain a nucleus and molecular grains of dark brown colouring matter. The offsets of these cells unite together, and form a fibrous web or stroma for this tunic (Köl liker).

In the inner part of the choroid the vessels form a network of capillaries with meshes smaller than elsewhere, whose interstices are rather less towards the back than the

Fig. 119.*



Connections with parts around.

Parts entering into the structure.

A plexus of blood-vessels with large meshes and pigment cells externally.

Capillaries internally.

* Inner view of the front of the choroid coat with its ciliary processes, and the back of the iris.—1. Iris with the fibres radiating from the inner to the outer edge: the circular band at the inner edge is the sphincter of the pupil. 2. Front of the choroid coat. 3. Ciliary processes inside the anterior terminal part of the choroid: the processes are connected at their inner ends by loops.

front of the eyeball: this part of the choroidal coat is described sometimes as a separate layer (*tunica Ruyschiana*).
 The stroma. The stroma or web formed by the outrunners of the cells is very fine at the inner part of the choroid, and the pigment cells are absent from it.

Structure of ciliary processes. In the ciliary processes there is also a texture of ramified bloodvessels though with larger capillary meshes; and the intermixed pigment cells lose their colouring matter towards the tips of the folds.

Pigmentary layer formed of cells. The pigmentary membrane (choroidal epithelium).—On the inner surface of the choroid coat and ciliary processes is a pigmentary lining. This structure is easily detached. It consists in great part of a single stratum of six-sided nucleated cells with granular contents (fig. 120, *b*), which are applied to each other by their edges. It has this constitution as far forwards as the ciliary processes, but in front of that line it is several layers deep, and the cells are rounded. This dark layer absorbs the superabundant rays of light entering the eyeball.

Fig. 120.*



Occasionally pigment absent.



Ciliary ligament.

altogether deficient in the cells, so that the vessels give a red appearance to the interior of the eye.

CILIARY LIGAMENT AND MUSCLE.—In the eye from which the sclerotic coat has been removed, the white band of the ciliary ligament, with the muscle close behind it (*annulus albidus*), may be seen in its natural position outside the front of the choroid coat.

Situation. Ciliary ligament.—This narrow circle, about $\frac{1}{40}$ th of an

* Pigment cells of the eyeball (Kölliker).—*a*. Ramified pigment cells of the choroid coat. *b*. Front view of the hexagonal cells of the pigmentary membrane. *b*. Side view of the same. *c*. Pigment of the cells.

inch thick, surrounds the iris, and is situate in the ball of the eye nearly opposite the junction of the cornea with the sclerotic tunic. It may serve the purpose of supporting the other coats at the fore part of the eye. Externally it is connected with the sclerotic, but a small interval the *sinus circularis iridis* exists between the two. Its fibres are circular; they are stiff, and resemble those of elastic tissue in their properties.

Connections
with other
parts.
Fibres.

The *ciliary muscle* (fig. 121, *b*) consists of unstriated fibres, and forms a grayish layer, about $\frac{1}{10}$ th of an inch wide, on the surface of the choroid coat, close to the ciliary ligament. It is connected in front with the sclerotic coat, and the radiating fibres of the posterior elastic layer of the cornea; its fibres are directed backwards and inwards, and end on the choroid coat. At its origin the muscle conceals the ciliary ligament. The nerves to the iris pierce its fibres.

Ciliary mus-
cle.

Attach-
ments.

Fig. 121.*



The iris (fig. 121, *c*) is a vascular and muscular structure, whose vessels are continuous with those of the choroidal coat.

Iris is vas-
cular and
muscular.

* View of the front of the choroidal coat and iris—external surface (Zinn).—*a*. Sclerotic coat cut and reflected. *d*. Choroid coat. *c*. Iris. *b*. Ciliary muscle: and the circular band between it and the iris represents the ciliary ligament. *e*. Ciliary nerves between the two outer coats. *f*. Veins of the choroid coat.

	Its position and connections may be observed in the different dissections that have been prepared.
Situation.	Placed within the ciliary ligament, it is suspended vertically in front of the choroid coat (fig. 117, ¹), and is pierced by an aperture for the transmission of the rays of light. It is
Form.	circular in form, is variously coloured in different persons, and is immersed in the aqueous humour.
Attachment.	By its circumference the iris is connected with the posterior elastic layer of the cornea and the ciliary ligament, and by means of the last body with the sclerotic coat close to the cornea. The anterior surface is free in the aqueous humour, and is marked by lines converging towards the pupil. The posterior surface is also free, and is covered with a thick layer of pigment, to which the name <i>uvea</i> has been applied (fig. 117, ²).
Anterior surface ; posterior.	
Situation and size of the central aperture.	The aperture in it is named the <i>pupil</i> of the eye ; this is slightly internal to the centre, and is nearly circular in form, but its size is constantly varying (from $\frac{1}{30}$ th to $\frac{1}{3}$ rd of an inch) by the contraction and relaxation of the muscular fibres, according to the degree of light acting on the optic nerve.
Component structures.	<i>Structure</i> .—The stroma of the iris is composed chiefly of fibres of areolar tissue, arranged in bundles, which are directed like rays towards the pupil. In it are involuntary muscular fibres, both circular and radiating, together with pigment cells. Vessels and nerves ramify through the tissue.
Muscular fibres : sphincter and dilator of pupil.	<i>Muscular fibres</i> .—The <i>sphincter of the pupil</i> (fig. 119) is a narrow band about $\frac{1}{30}$ th of an inch wide, which is close to the pupil on the posterior aspect. The <i>dilator of the pupil</i> is said to begin at the outer border of the iris, and its fibres, collected into bundles, join internally the sphincter.
How they act.	Enlargement of the pupil is supposed to be effected by shortening of the radiating fibres ; and diminution, by contraction of the circular ring. The movements of the iris regulate the quantity of light admitted into the eye.
Position and form of pigment cells.	The <i>pigment cells</i> are spread out in the stroma, and are disposed also on both surfaces. In the substance of the iris they are ramified and irregular as in the choroid (fig. 120, A) ; on the fore part they are ovalish or rounded, but still ramified ; and behind, where there is a thick layer (<i>uvea</i>), the cells are rounded and filled with granules. The colour of the iris is dependent upon the colour and position of the pigment.
Pigment gives colour.	
Arteries are radiating	The <i>arteries</i> of the iris have a looped arrangement : they are derived chiefly from the long and the anterior ciliary

branches, but some come from the vessels of the ciliary processes. On arriving at the ciliary muscle the long ciliary arteries form a circle around the margin of the iris; from this loop other anastomotic branches are directed towards and looped the pupil, near which they terminate in a second arterial circle, and end in small veins.

The *nerves* of the iris divide into branches, which communicate and extend towards the pupil; they are without dark outline, and their ending is not known.

Membrane of the pupil.—In the fetus before the seventh month the aperture of the pupil is closed by a vascular transparent membrane. This structure is attached to the anterior surface of the iris, over the situation of the inner vascular circle, and divides into two distinct chambers the space in which the iris is suspended. Vessels shoot into it from the circle before referred to, and communicate across the middle line; but at about the eighth month the vessels become impervious, and at the time of birth only fragments of the membrane remain.

CILIARY VESSELS AND NERVES.—The ciliary arteries are offsets of the ophthalmic (p. 48), and supply the choroid coat, the ciliary processes, and the iris. They are classed into posterior and anterior; and two of the first set are named long ciliary; but they will not be seen without a special injection of the vessels of the eye.

The *posterior* (short) *ciliary* branches (fig. 121) pierce the sclerotic coat around and close to the optic nerve, and running on the surface of the choroid membrane enter its substance. Two of this set (long ciliary) are directed forwards to the ciliary ligament, one on each side of the eyeball, and form a circle around the iris in the ciliary muscle, as before explained, before being distributed in it. In the eye the outer one lies rather above, and the inner rather below the level of the middle of the ball.

The *anterior ciliary* arteries are smaller than the posterior, and arise at the front of the orbit, chiefly from muscular branches; they pierce the sclerotic coat about a line behind the cornea, and join the arterial circle of the long ciliary vessels before they end in the iris. In inflammation of the iris these vessels are enlarged, and form a ring around the cornea.

The *veins* leaving the choroid coat are commonly four in number, and the branches entering these trunks form arches (*vasa vorticosa*) on the surface (fig. 121, *f*): they perforate the sclerotic layer at separate points, midway between the

Nerves of the iris.

Membrane of the pupil in the fetus.

Situation;

time of disappearance.

Arteries of the eyeball are

posterior at the back;

two of them named long ciliary.

Anterior ciliary at the front.

Veins end in the ophthalmic.

cornea and the optic nerve, and end in the ophthalmic vein.

Ciliary nerves

The *ciliary nerves* (fig. 121) are derived from the lenticular ganglion, and from the nasal nerve (p. 47). Entering the back of the eyeball with the arteries, they are continued forwards with the vessels between the sclerotic and choroid coats nearly as far as the ciliary muscle: at this spot the nerves send offsets to the cornea, and pierce the fibres of the ciliary muscle to enter the iris, but their manner of ending is unknown. Offsets from the nerves supply the ciliary muscle.

end in iris and ciliary muscle.

Space contains aqueous humour;

CHAMBER OF THE AQUEOUS HUMOUR (fig. 117).—The space between the cornea in front and the lens behind, in which the iris is suspended, contains a clear fluid named the aqueous humour. In the fetus this interval is separated into two distinct parts by the iris and the pupillary membrane, but in the adult it is only partly divided, for the two communicate through the pupil. The boundaries of the two chambers may be seen in the eye on which a vertical section has been made.

is partly divided into two by the iris.

Anterior part.

Posterior;

its boundaries.

The anterior chamber is the larger part of the space before mentioned; it is limited in front by the cornea, and behind by the iris and the ciliary ligament. The posterior chamber is less than half the size of the anterior. In front it is bounded by the iris; behind by the lens and a piece of the membrane (suspensory ligament of the lens) on the front of the vitreous humour; and at the circumference by the ciliary processes.

Aqueous humour.

The *aqueous humour* is quite transparent, and consists nearly of pure water. A small quantity of chloride of sodium, with some extractive matter, is in solution in it. It has been supposed that this fluid is secreted by a special membrane lining the cavity, but evidence of the existence of such a structure is wanting.

Retina continuous with optic nerve.

THE NERVOUS TUNIC OR RETINA.—This coat (*tunica nervea*) is continuous with the optic nerve, and is the most delicate of all the structures of the eyeball. On it the image of objects is produced by the rays of light being brought to a focus in the bottom of the eye.

Dissection to see the retina.

Dissection.—The retina can be satisfactorily examined only on an eye that is used before forty-eight hours have expired after death. To bring it into view on the eyeball on which the choroid coat was dissected, the choroidal covering must be torn away carefully with two pair of forceps whilst the eye is immersed in water or spirit.

If an entire eye is used for the purpose, a thread may be

passed through the cornea, and fastened to a pin fixed in wax; then on removing in a fluid the sclerotic and choroid coats, the retina will be laid bare.

The interior of the retina may be seen in the eye from which the cornea, the iris, and the corpus ciliare have been removed in front.

The *retina* is the most internal of the three concentric strata in the globe of the eye, and is situate between the choroid coat and the transparent mass (vitreous humour) in the interior. It is moulded upon, and supported by the vitreous body; and its form is that of a segment of a sphere, but its aperture in front is very large. Beginning behind at the optic nerve, this thin layer extends forwards nearly as far as the ciliary ligament, viz., to the spot at which the choroid coat becomes folded (outer margin of the corpus ciliare), where it ends in a wavy border—the *ora serrata*. Where the retina ceases in front a thin layer of elongated nucleated cells, which are not nerve elements, is continued on to the tips of the ciliary processes (fig. 117, ').

This nervous expansion is of a pinkish gray colour, and is semitransparent when fresh, so that an image can be seen on it at the bottom of the eye when the two external coats are removed; but it soon loses this translucency, and is moreover rendered opaque by the action of water and other substances. Its thickness is greater at the posterior than at the anterior part of the eyeball.

On the outer surface are some fine shreds, fragments of a structure (Jacob's membrane) to be noticed presently, which float in the fluid in which the preparation may be placed; and in a fresh eye, on which the coats have been removed from behind, a continuous layer of this membrane may be detached with care.

On looking to the inside through the vitreous body, the surface will be found covered with folds, but these are accidental, in consequence of the membrane having lost its proper support; and at the spot where the optic nerve expands (porus opticus) is the central artery of the retina. In the interior of the human eye, in the axis of the ball, and $\frac{1}{10}$ th of an inch outside the entrance of the optic nerve, is a slightly elliptical yellow point, $\frac{1}{12}$ th of an inch in diameter, which is named the *yellow spot* (limbus luteus of Sömmerring). Almost in the centre of that spot is a minute hollow, the *fovea centralis*, which appears black in consequence of the thinness of the wall allowing the dark pigment outside to be seen.

Situation in eyeball.

Form and extent.

Cells prolonged in front.

Colour;

transparency and thickness.

Outer surface is flocculent.

On the inner surface are seen

porus opticus,

yellow spot,

fovea centralis.

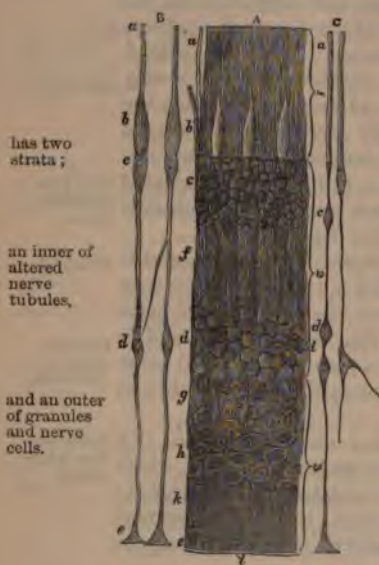
Layers in
the retina.

Structure (fig. 122).—In the retina are three layers or strata of different materials, together with bloodvessels: viz., an inner (³), composed of nerve elements; an outer (Jacob's membrane), formed of peculiar bodies (¹); and an intermediate or granular layer (²). Passing vertically through all the layers of the retina are other fine threads—fibres of Müller.

One of nerve
substance

a. The layer of nerve substance (³) is made up of the same

Fig. 122.*



elements as the gray matter of the encephalon, viz., of a molecular matrix containing different-sized nerve cells, with nerve fibres instead of nerve tubes; these constituents have the following arrangement:—The tubules of the optic nerve (*k*), having become solid in texture, and gray in colour from the absence of the white substance of Schwann, radiate from the end of the optic trunk, and communicate together to construct a thin stratum at the inner aspect of the nervous layer; this delicate lamina diminishes in strength as it is followed forwards. Outside the nerve fibres is a stratum of the molecular material (*g*) with large pale pyriform and roundish nucleated stellate nerve cells (*h*): this begins around the entrance of the optic nerve, and becomes thinner, like the fibrous

layer, as it extends forwards. Offsets of the cells are said to join internally the nerve fibres, and to enter the granular layer (*d*) externally.

Blood-ves.

In the nervous layer is a *plexus of bloodvessels*, which is

* Magnified vertical section, A, of the retina (Kölliker).—1. Columnar layer with rods, *a*, and cones, *b*. 2. Granular layer with outer layer, *c*, and inner layer of granules, *d*, and intermediate non-granular part, *f*. 3. Nervous layer with, *h*, nerve cells, and *k*, nerve fibres: outside the cells is a finely granular part, *g*, and inside the fibres a limiting membrane, *e*.

B. Cones of the outer layer, 1, connected with fibres (fibres of Müller), and passing through the retina.

C. Rods of the outer layer, 1, united with fibres of Müller, like the cones.

derived from the central vessels of the retina contained in the optic nerve (p. 48). When the nerve becomes membraniform the artery divides into four or five branches; these pierce the stratum of fibres, and end in a network of capillaries amongst the nerve cells outside them, like the vessels in the gray substance of the encephalon, and without forming a separate layer. The larger branches of the artery keep clear of the axis of the eyeball, and only capillaries occupy the yellow spot. In the fetus a branch of the artery is distributed to the back of the lens.

In animals a marginal vessel runs circularly round the ball at the anterior termination (ora serrata) of the retina.

b. The *outer stratum* ⁽¹⁾ or columnar layer of the retina (Jacob's membrane) consists of two different elements—rods and cones, which are arranged with their ends inwards and outwards.

The *rods* (*c*) are elongated solid particles, which are pointed at the inner end, and are the more numerous of the two kinds of bodies.

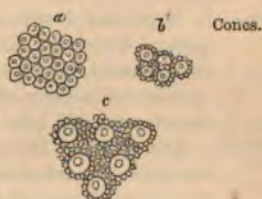
The *cones* (*b*) are shaped like a flask with a long neck, and have the larger end turned inwards: they do not project so far out as the rods. When viewed on the outer surface, the cones form large isolated swellings amongst the ends of the rods (fig. 123, *c*), and at a deeper level. By their inner ends both bodies are joined to the fibres of Müller.

In the fresh state both are clear and homogeneous, with a glistening appearance, but these characters are soon destroyed by water and other fluids.

c. The *granular layer* ⁽²⁾ consists of innumerable rounded or ovalish bodies, collected into two sets (*c*, *d*), with an intervening fine molecular material. The intervening portion has a striated appearance, from the passage of the fibres of Müller through it.

The *fibres of Müller* (*v*, *c*) pass vertically through the substance of the retina, from the bodies in the columnar layer to the limiting membrane on the inner surface. They are extremely fine threads, and are aggregated into bundles as they penetrate between the optic fibres; those of the

Fig. 123.*



* Microscopic appearance of the outer surface of the retina.—*a.* Over the yellow spot. *b.* Near the spot. *c.* Middle of the retina. The larger rings represent the cones, and the smaller ones the rods, seen endwise in all the figures.

Position and extent.	cones are said to be connected over the yellow spot with the inner bodies (<i>d</i>) in the granular layer, and with offsets of the nerve cells (Kölliker).
Membrane lining retina.	The <i>limiting membrane</i> is a very delicate layer on the inner surface of the retina, which is joined by the fibres of Müller, and resembles the elastic layers of the cornea in its properties.
Constituents of retina at yellow spot.	In the <i>yellow spot</i> the nerve cells of the inner stratum form a continuous layer : whilst the nerve fibres extend only into the circumference, and the molecular material of the same layer is absent over the fovea centralis. The granular layer and the fibres of Müller are absent over the central fossa. Only the conical elements of Jacob's membrane (fig. 123, <i>a</i>) are found in this spot.
Colour.	The colour of the part is due to yellow pigment diffused through all the textures except Jacob's membrane. Water removes it readily.
Vessels.	Capillary vessels occupy the spot, whilst the larger branches pass around.
Vitreous body.	VITREOUS BODY. —A transparent mass fills the greater part of the space within the coats of the eyeball, which has been named vitreous body from its resemblance to glass ; it consists of a clear aqueous fluid, contained in a translucent membrane, and has the consistence of jelly.
To obtain a view of it,	<i>Dissection.</i> —The vitreous body may be seen on the eye on which the retina was dissected, by taking away the retina, the ciliary ligament and processes, and the iris.
and of its front.	To obtain a view of its anterior part with the lens in situation, an eyeball should be pinned upright on wax ; the sclerotic and choroid coats should be cut through about a quarter of an inch behind the cornea (p. 779) ; and on removing carefully the cornea, ciliary ligament, and ciliary processes, the vitreous body will become apparent.
Part of the globe filled by it.	The <i>vitreous body</i> is globular in form, and fills four fifths of the ball of the eye, reaching forwards nearly to the iris. In front the vitreous body is slightly hollowed, and receives the lens with its capsule, to which it is closely united. The <i>fluid</i> of the vitreous body has nearly the same composition as the aqueous humour. Enveloping the whole is a thin membrane named hyaloid.
Composition.	
Hyaloid membrane.	The <i>hyaloid membrane</i> is the fine transparent covering of the vitreous body. It passes continuously over the surface of that mass ; and in the fetus it is connected with fibres that penetrate the vitreous body. On the inner aspect are a few delicate nuclei. At the fore part it is closely united
Connections.	

with the membrane supporting the lens (fig. 117, ⁵), and ends by joining the back of the capsule of the lens. At the bottom of the eyeball, opposite the optic nerve, the membrane is also closely connected to the parts around. At this spot in the fetus it was reflected inwards, through the centre of the vitreous mass, along the bloodvessels supplying the back of the lens.

This membrane and the vitreous mass are extra-vascular, and receive their nutritive material from the vessels of the ciliary processes and retina.

Suspensory ligament of the lens (Retzius).—This is a transparent membranous structure (fig. 117, ⁵), placed around the lens at the front of the hyaloid membrane, and between the anterior termination (ora serrata) of the retina and the lens capsule. After the ciliary processes of the choroid coat are detached from it, dark lines of pigment cover the surface; and when these are washed away plaits or folds, ciliary processes, come into view, which resemble the processes of the choroid coat, but are less prominent and longer. The two sets of folds are dovetailed together, the prominences of one membrane being received into hollows on the other; and thus the membrane gains a fixed point for supporting the lens. In this membrane are stiff longitudinal and elastic fibres.

Canal of Petit.—Around the margin of the lens is a small canal (fig. 117, ⁶) about one tenth of an inch across, which has received the above name. It is situate between the plaited part of the suspensory ligament and the front of the hyaloid membrane—being the interval of separation between the two. When the canal has been opened and distended with air, it is sacculated at regular intervals, like the large intestine, in consequence of the inflation of the plaits of the anterior boundary. The margin of the capsule of the lens projects into the space.

CRYSTALLINE LENS AND ITS CAPSULE.—The crystalline lens is situate behind the pupil of the eye (fig. 117, L), and acts in bringing to a focus on the retina the rays of light passing through that aperture.

The *capsule* is a firm and very elastic transparent case, which is permeable to fluid, and closely surrounds the lens. It is seated in a hollow on the front of the vitreous body. The anterior part projects towards the iris and the pupil; whilst the posterior is received in the vitreous body, to which it is inseparably united. The circumference of the case corresponds with the canal of Petit.

Its anterior surface (fig. 117, ⁷) is free in the posterior

Process
into the
vitreous
mass.

How
nourished.

Suspensory
ligament.

Extent;

is marked
by folds
called ciliary
processes.

Nature and
use.

Canal of
Petit.

Situation.

Anterior
part saccul-
lated.

Lens of the
eyeball.

Capsule of
the lens.

Situation
and connec-
tions.

Its anterior

part is firm
and trans-
parent.

Posterior
thin and
fibrous.

Vessels to it.

Open cap-
sule of lens.

Surfaces are
curved un-
equally ;

chamber of the eye, and gives attachment towards the circumference ($\frac{1}{16}$ th of an inch off) to the suspensory ligament. The anterior part of the capsule is four or five times thicker than the posterior, as far outwards as to the attachment of the suspensory ligament, and supports itself after the removal of the lens ; it is firm and quite transparent, being structureless, and remains clear for some time when immersed in spirit, acids, and boiling water, like the elastic layers of the cornea. The posterior part of the capsule (^a) is thin and membranous, and decreases in thickness towards the centre : it is joined by the hyaloid membrane of the vitreous body.

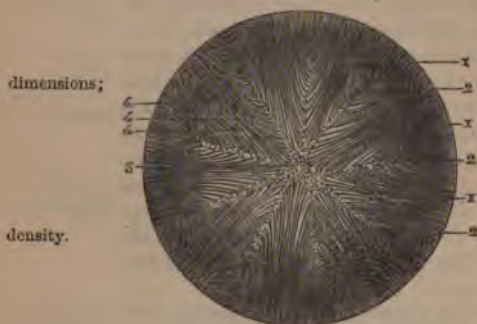
In the adult human eye the capsule of the lens is not supplied with bloodvessels ; but in the fetus a branch of the central artery of the retina passes through the vitreous body to supply it on the posterior aspect.

Dissection.—The lens will be obtained by cutting across the thin membranous capsule in which it is enclosed.

The lens.—When the lens is removed from its capsule, it is a solid and transparent doubly convex body ; but the

curves are unequal on the two surfaces, the posterior being greater than the anterior. Its margin is somewhat rounded. Its measurement from side to side is from one third to half an inch, and from before back about one fourth of an inch. The density increases from the circumference to the centre ; for the superficial part rubs off easily with the

Fig. 124.*



finger ; but the deeper portion is hard and firm, and is named the *nucleus*.

Lines on the
surfaces.

On each surface are three lines diverging from the centre, and reaching towards the margin (fig. 124) ; they are the edges of planes or septa, and are so situate that those on one side are intermediate in position to those on the other.

* Planes or septa at the pole of the lens, with the attached fibres.—
1. Fibres reaching the centre of the lens between the planes. 2. Fibres joining the extremity of a plane or septum. 4. Fibres uniting with the plane between its extremities.

In the human eye they are not distinctly seen, because they bifurcate repeatedly as they extend outwards.

Covering the surface of the lens,* and connecting it with the capsule, is a layer of very transparent nucleated cells (fig. 125, *a*), which can be recognised only in a fresh eye. After a little time these cells absorb moisture from the aqueous humour, and breaking down form the fluid that has been called *aqua Morgagni*; but naturally there is not any fluid between the lens and its capsule.

A layer of cells joins to the capsule.

Structure.—After the lens has been hardened by spirit or boiling, it may be demonstrated to consist of a series of layers arranged one within another, like those in an onion. Under the microscope each layer may be seen to be constructed of minute parallel fibres. No bloodvessels are found in its texture. It consists mostly of albumen.

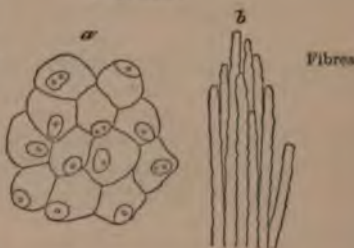
Lens is laminar.

The *laminae* of each surface have their apices in the centre, where the septa meet, and may be detached from one another at that spot, and turned outwards.

Form of the laminae.

Fig. 125.†

The constituent *fibres* of the laminae are about $\frac{1}{5000}$ th of an inch in diameter, solid and rather flat, but most flattened at the margin of the lens; and the deeper fibres are narrowed and less distinct.‡ The edges are slightly wavy (fig. 125, *b*), and each fibre touches six others; viz., two on each side, with one above, and another below: contiguous fibres are therefore dovetailed together, and this interlocking is best seen in the lens of the codfish.



Fibres

are wavy the edge, and six-sided,

They are connected at their extremities to the partitions on the opposite surfaces of the lens in this way:—those that are attached to the pole or the spot where the septa meet on the one aspect, are fixed to the extremity of a septum on

and attach to the sept by their ends.

* According to some Anatomists the cells exist only on the anterior surface of the lens.

† Cells and fibres of the lens magnified (Bowman).—*a*. Cells uniting the body of the lens to the capsule. *b*. Lens-fibres with slightly wavy edges.

‡ The fibres are described by K lliker as tubes containing a "clear viscid albuminoid matter," and terminating at the septa in clavate and fusiform enlargements.

the other aspect ; and the rest of the fibres passing between two septa are connected at one end nearer to the pole, and at the other end farther from it, with the exception of the middle fibres which are at the same distance from the ends of the septa.

Changes in
situation ;

Changes in the lens with age.—In infancy the lens is situate further forwards than in adult age, and touches the iris.

form,

Its form is nearly spherical in the fetus, but its convexity decreases with age, particularly on the anterior aspect, until the lens becomes flattened in old people.

colour, and
consistence.

In the fetus it is reddish in colour, is soft, and is not quite transparent ; in youth and mature age it is firm and clear ; and in old age it becomes denser and of a yellowish colour.

CHAPTER XI.

DISSECTION OF THE EAR.

THE organ of hearing is made up of many complex parts, which are lodged in, or are attached to the surface of the temporal bone.

Constitu-
ents.

The fundamental part in this organ, as in the eyeball, is an expansion of a special nerve over a membrane containing fluid. For its protection this structure is enclosed in bone. It is surrounded by certain accessory bodies which collect, and convey to it the undulations of sound.

Outline of
the ele-
ments of the
organ of
hearing.

The several parts constituting the auditory apparatus may be arranged into those outside, and those within the substance of the temporal bone.

Arrange-
ment into
two sets.

The external set (outer ear), which may be first examined, include the pinna or auricle, and the auditory canal: the former has been noticed at page 36, and the latter is described below.

Outer set.

THE AUDITORY CANAL (*meatus auditorius externus*) is the passage which leads from the pinna to a cavity in the temporal bone named the tympanum, and transmits inwards sounds.

Auditory
canal.

Dissection.—To obtain a view of this canal, a recent temporal bone is to be taken, to which the cartilaginous pinna remains attached. After the soft parts are removed, the squamous part of the bone in front of the Glasserian fissure is to be sawn off; and the fore part of the meatus, except the portion below that gives support to the thin *membrana tympani*, is to be cut away with a bone forceps.

How to ob-
tain a view
of it.

This canal is about one inch and a quarter in length, and is formed partly by bone, and partly by cartilage and membrane. It is directed forwards somewhat obliquely; and sometimes it is bent downwards rather beyond the middle, so that the floor slopes from that spot both outwards and inwards. In shape it is rather flattened from before backwards; and it is narrowest in the osseous part. The outer

Length.

Direction.

Size and
shape.

Cartilagi-
nous part

is deficient
above.

Osseous
part.

Outer end;

inner end.

Condition in
the fetus.

Lining
membrana
is derived
from the
skin.

Ceruminous
glands.

Vessels.

Nerves.

Internal set
of the audi-
tory parts.

Tympanum.

extremity is continuous with a hollow (concha) of the external ear, and the inner is closed by the membrana tympani.

The *cartilaginous* is the largest part. It is about half an inch in length, and is formed chiefly by that portion of the pinna of the outer ear which is attached to the margin of the meatus; but at the upper and posterior aspect the cartilage is deficient, and the tube is closed by fibrous tissue. Two or three fissures (fissures of Santorini) are found in the piece of cartilage.

The *osseous* part is about three quarters of an inch long in the adult, and is rather constricted about the middle, near which it may be bent as before said. Its outer extremity is dilated, and the posterior projects further than the anterior wall; the greater part of the margin is rough, and gives attachment to the cartilage of the pinna. The inner end is less dilated, and is marked in the dry bone, except at the upper part, by a groove for the insertion of the membrane of the tympanum; it is so sloped that the anterior wall juts beyond the posterior by about two lines.

In the fetus the osseous part of the meatus is absent. After birth it grows out of the osseous ring (tympanic bone) which supports the membrana tympani, and joins the rest of the temporal bone.

Lining of the meatus.—A prolongation of the integument lines the auditory passage, and is continued over the membrane of the tympanum in the form of a thin pellicle. At the entrance of the meatus are a few hairs. In the subcutaneous tissue of the cartilaginous part of the meatus are some ceruminous glands, resembling in form and arrangement the sweat glands of the skin, which secrete the ear wax, and open on the surface by separate orifices; these are most abundant in that portion of the tube which is formed by fibrous tissue.

Vessels and nerves.—The meatus receives its *arteries* from the posterior auricular, the internal maxillary, and the temporal branch of the external carotid trunk. Its *nerves* are derived from the auriculo-temporal branch of the fifth nerve, and enter the auditory passage between the bone and the cartilage (p. 97).

The internal constituents of the auditory apparatus are enclosed within the temporal bone, and consist of two large spaces, named tympanum and labyrinth, with their accessory parts.

The **TYMPANUM**, or drum of the ear, is a hollow interposed between the meatus auditorius and the deeper labyrinthic

cavity. It communicates with the pharynx by a tube (Eustachian), through which the mucous membrane and the air have access to it; and it is traversed by a chain of small bones, with which special muscles and ligaments are connected. Numerous and minute vessels and nerves are contained in the space.

Dissection.—The tympanic cavity is to be opened in both a dried and a recent bone.

On the dry temporal bone, after removing most of the squamous portion by means of a vertical cut of the saw through the root of the zygoma and the Glasserian fissure, the tympanum will be brought into view by cutting away with the bone forceps the anterior part of the meatus auditorius, and the projecting bone above that forms the roof of the cavity.

Open it in the dry bone,

In the recent bone, in addition to the preparation already made of the meatus auditorius, only the roof of the tympanum should be taken away as far as may be necessary, and without doing injury to the membrana tympani, the chorda tympani nerve, and the chain of bones with its muscles.

and in the recent bone.

Form.—The cavity of the tympanum has the form of a small, round, flat box, placed on the edge;—the outer and inner boundaries being flattened and the circumference circular. Its size is greater from point to point of the circumference than across the space or from without inwards; in the former direction it is about half an inch, but in the latter not more than half that measurement.

Form and dimensions.

The *inner boundary* is of greater extent than the outer, and on it the following objects are to be noticed. Occupying nearly the whole surface is the large projection of the *promontory* which becomes pointed posteriorly, and is marked by two or three minute grooves that lodge the nerves forming the anastomosis of Jacobson. Above and below the posterior or narrowed part of the promontory is a large aperture, and both lead into the labyrinthine spaces. The upper opening resembles in shape the half segment of a circle, with the convexity placed upwards, and is named *fenestra ovalis*: towards the inner or vestibular cavity (part of the labyrinth) it has a sharp, prominent margin; and over it, in the recent state, the inner bone (stapes) of the osseous chain is fixed. The lower aperture, named *fenestra rotunda*, is rather irregular or triangular in shape, and leads into the cochlea: it is situate within a funnel-shaped hollow, somewhat oval in form on the surface. In the recent state

Inner wall is marked by promontory and its grooves.

Fenestra ovalis.

Fenestra rotunda.

it is closed by a thin membrane, the *secondary membrane* of the tympanum.

In outer
boundary,
membrana
tympani
and Glasser-
ian fissure.

The *outer boundary* of the cavity is formed by the *membrana tympani*, and by a small part of the surrounding bone. Above the membrane and in front of it, is the *Glasserian* or *glenoid fissure*, which is occupied in the fresh condition of the body by the long process of one of the small bones named *malleus* and by a small muscle, the *laxator tympani*. Crossing the membrane towards the upper part is the *chorda tympani* nerve, which passes through an aperture internal to or in the *Glasserian fissure*.

Circum-
ference;

The *circumference* of the tympanum is circular, and in some parts it is rough and uneven on the surface. In passing around the cavity the student may observe the following points in its anatomy.

the roof;

The roof is wide and flattened, and consists of the thin osseous plate between the cranial and tympanic cavities.

and floor.

The floor is narrow, and is curved over the subjacent jugular fossa; in the dry bone it has more or less of an areolar or spongy texture, as well as some small apertures communicating with the fossa beneath.

At back,

At the posterior part of the circumference, towards the roof, is one large, together with other smaller apertures leading into the mastoid cells. Below this aperture, but near the inner wall and on a level with the narrowed part of the promontory, is a small conical projection named the *pyramid*: this is perforated by an aperture, and contains the *stapedius* muscle. A minute canal connects the hollow in this projection with the aqueduct of Fallopius. Attaching generally the pyramid to the above-mentioned part of the promontory, is a small round spiculum of bone. In a line with the pyramid, and arching upwards from it above the *fenestra ovalis*, is a bony ridge marking the situation of the aqueduct of Fallopius.

opening of
mastoid
cells;
pyramid;

aqueduct of
Fallopius.

In front
canals for
tensor tym-
pani and
Eustachian
tube.

The front of the tympanic cavity corresponds with the carotid canal, only a thin scale of bone intervening. In it are the apertures of two canals that lie on the outer side of the passage for the carotid artery:—the upper one contains the *tensor tympani* muscle, and the lower one is the *Eustachian tube*. Between the two canals is a thin osseous lamina, which is hollowed above and dilated at the inner end, and is named *processus cochleariformis*.

Some parts that have been referred to above, viz. the *membrana tympani*, the *Eustachian tube*, and the *secondary tympanic membrane*, require a separate notice.

The *membrana tympani* (fig. 126) is a thin partition between the meatus auditorius and the cavity of the tympanum. It is oval in form, and is attached by its circumference to a

Membrana tympani:

Fig. 126.*



groove at the inner end of the auditory passage; but in the fetus it is fitted into a separate osseous ring, the tympanic bone. The membrane is placed very obliquely with respect to the meatus, so that it forms with the floor of that passage an angle of 45 degrees, and the outer surface is directed downwards. Towards the auditory canal the surface is concave; but in the tympanum it is convex, and attached to its upper half is the handle of the malleus (2) one of the tympanic ossicles.

state in the adult and the fetus.

Situation;

surfaces.

Structure.—This membrane is formed of three strata or structures, an external, internal, and middle. Two of these are obtained from the common covering and lining of the body: thus, the outer one is part of the integuments of the meatus; and the inner layer is derived from the mucous membrane of the tympanum. The middle stratum is formed of fibrous tissue, and is fixed to the groove in the bone as before said. From the centre, where it is connected with the handle of the malleus, fibres radiate externally towards the circumference; and near the margin at the inner surface is a band of stronger circular fibres, which diminishes gradually and ceases towards the middle.

It is formed of a cuticular, epithelial, and

fibrous stratum.

The *Eustachian tube* is the channel through which the tympanic cavity communicates with the fauces. It is about an inch and a half in length, and is directed downwards and inwards to the pharynx. Like the meatus auditorius, it is partly osseous and partly cartilaginous in texture.

Eustachian tube has

The *osseous* part is rather more than half an inch in length, and is narrowed at the middle. Its opening in the tympanum, and its situation with respect to the canal for the

an osseous part;

situation

* Inner and outer views of the membrane and ossicles of the tympanum: the right-hand figure shows the inner surface.—1. Membrana tympani. 2. Malleus. 3. Stapes. 4. Incus bone.

tensor tympani muscle have been alluded to ; its course in the temporal bone is along the angle of union of the squamous and petrous portions, outside the canal of the carotid artery. Externally it ends in a dilated and somewhat oval opening, with the longest measurement in a vertical direction and with an irregular margin, which gives attachment to the special cartilage completing the canal.

The *cartilaginous* part of the tube is nearly an inch in length, and extends from the temporal bone to the interior of the pharynx (see p. 134).

Through this tube the mucous membrane of the tympanum is continuous with that of the pharynx ; and through it, by reason of its inclination downwards, the mucus passes from that cavity.

The *secondary membrane of the tympanum* is placed within the fenestra rotunda, and is rather concave towards the tympanum, but convex towards the cochlear passage which it closes.

It is formed of three strata, like the membrane on the opposite side of the tympanum, viz. an external or mucous, derived from the lining of the tympanum ; an internal or serous, continuous with that clothing the cochlea ; and a central layer of fibrous tissue.

OSSICLES OF THE TYMPANUM.—These are three in number, and are placed in a line across the tympanic cavity. The outer one is named malleus from its resemblance to a mallet ; the next, incus, from its similitude to an anvil ; and the last, stapes, from its likeness to a stirrup. For the examination of these little bones, the student should be provided with some separate dry specimens, besides the ossicles that are in position in the cavity.

The *malleus* (fig. 127, A) is the longest bone, and is twisted and bent. It is large at one end (head) and small and pointed at the other (handle) ; and it has besides two processes with a narrowed part or neck. The *head* or capitulum (¹) is free in the cavity, is oval in shape, and is smooth except at the back, where there is a depression (²) for articulation with the next bone. The *neck* is the slightly twisted part between the head and the processes. The *handle* or manubrium (³) decreases in size towards the tip, and is flattened from before backwards, except at the extremity where it is compressed from within outwards : to its outer margin the membrana tympani is connected. The *processes* of the bone are two in number, long and short :—The *short* one (⁴) springs from the root of the handle on the

outer side, and is connected with the membrane of the tympanum. The *long* process—*processus gracilis* (³), is a flattened slender piece of bone, which is connected with the neck of the malleus at the anterior aspect, and extends into the Glasserian fissure: in the adult this process is joined with the surrounding bone, and cannot be separated from it.

The *incus* is a flattened bone (fig. 127, *B*), and consists of *Incus*, a body and two processes. The *body* is hollowed at the its body;

Fig. 127.*



upper and anterior part (⁴) to articulate with the malleus. The two *processes* (long and short) extend from the side opposite to the articulation:—The shorter process (³) is somewhat conical, and is received into the aperture of the mastoid cells: the long process (²) decreases towards the extremity, where it curves and ends in a rounded and convex point, the *orbicular* process.

The *stapes* (fig. 127, *C*) has a base or wider part, and two sides or crura that are blended at the opposite end in a head like a stirrup. The *base* (⁴) is formed by a thin osseous plate, which is convex at one margin and almost flat at the other, corresponding with the shape of the fenestra

* Ossicles of the tympanum separate and united.—A. Malleus: 1. Head. 2. Handle. 3. Long process. 4. Short process. 5. Articular surface. B. Incus: 1. Head. 2. Long process. 3. Short process. 4. Articular surface. C. Stapes: 1. Head. 2. Posterior crus. 3. Anterior crus. 4. The base. C*. View of the end of the stapes. D. The three ossicles articulated together.

- head*: ovalis: the surface that is turned to the vestibule is convex, whilst the opposite is excavated. The *head* (') is marked by a superficial depression which receives the orbicular process of the incus; and below it is a constricted part, the
- crura*. neck of the bone. The *crura* extend from the base to the neck, and are grooved on the inner surface like the base: the anterior crus (") is shorter and straighter than the other.
- Position of the malleus*. *Position of the ossicles* (fig. 127, D).—The *malleus* is placed vertically in the tympanum, with the head upwards, and the articular surface turned backwards to its articulation with the incus: its handle is attached externally to the membrana tympani; and its long process is directed forwards into the Glasserian fissure. The *incus* is so placed that the long process is vertical, and the short one horizontal. Externally it is united with the malleus, and its processes are thus disposed:—the short one is received into the aperture of the mastoid cells; and the long process descends, like the handle of the malleus, but rather posterior to it and nearer the inner wall of the cavity, to join inferiorly with the stapes. The *stirrup* bone has a horizontal position, with the crura directed forwards and backwards: its base is fixed over the fenestra ovalis, and its head is united with the long process of the incus.
- and of the stapes*. *Ligaments of the ossicles*.—The small bones of the tympanic cavity are united into one chain by articular ligaments, and are further kept in position by ligaments that fix them to the surrounding wall.
- The bones have two sets of ligaments*. *From one bone to another*.—The ossicles are connected together at the points where they touch by articulations corresponding with the joints of larger bones; for the osseous surfaces are covered with cartilage, and are surrounded by a capsular ligament of fibrous tissue, whilst a synovial sac is present in the joint. One articulation of the nature above described exists between the heads of the malleus and incus, and a second between the extremity of the long process of the incus and the head of the stapes.
- by joints*. *Between the bones and the wall*.—The bones are kept in place by the reflection of the mucous membrane, and by special ligaments. From the head of the *malleus* a short suspensory band of fibres is directed upwards to the roof of the tympanum. Another ligamentous band passes backwards from the *incus*, near the end of its short process, to the posterior part of the containing cavity. And the base of the *stapes* is connected to the margin of the fenestra ovalis by fibres that constitute an orbicular ligament.
- or to fix them to the tympanic wall*.

In the recent bone the thin mucous membrane closes the interval between the crura of the stapes, and is attached to the groove on their inner aspect. Membrane of stapes.

Muscles of the ossicles.—Three muscles which possess transversely striated fibres are in connection with the chain of bones; two of these are attached to the malleus, the other to the stapes. Three muscles to the ossicles.

The *tensor tympani* (internal muscle of the malleus) is contained in a special bony canal, which must be laid open to see it completely. It is the largest and most distinct of the muscles of the tympanum, and takes the shape of the containing tube. The muscle arises from the surface of its bony canal, also slightly in front from the cartilage of the Eustachian tube. Posteriorly it ends in a tendon which, contained in a sheath, is reflected over the end of the cochleariform process as over a pulley, and is inserted into the inner border of the handle of the malleus, near its base. It receives a special nerve from the otic ganglion. Tensor tympani lies in a bony canal.
Origin.
Insertion into malleus.

The *stapedius* is lodged in the canal hollowed in the interior of the pyramid. Arising from the circumference of the tube, the muscle ends superiorly in a small tendon; this issues from the pyramid, and, encased in a sheath, is inserted into the neck of the stapes at the posterior part. Stapedius is in the pyramid
attached to stapes.

Laxator tympani (external muscle of the malleus).—It is connected externally with the spinous process of the sphenoid bone; and its tendon, passing through the Glasserian fissure, is attached to the neck of the malleus above the processus gracilis. Laxator tympani.
Origin.
Insertion.

Mucous membrane of the tympanum.—The mucous lining of the tympanic cavity adheres closely to the wall, and is continuous with that of the pharynx through the Eustachian tube. It assists to form part of the membrana tympani, and of the secondary membrane in the fenestra rotunda, and is continued moreover into the mastoid cells through the aperture leading into them; it is reflected also over the chain of bones and the muscles and ligaments. Its surface is covered with a ciliated epithelium. A layer of epithelium can be detached from the inner surface of the membrana tympani, in the same manner as a cuticular stratum may be separated on the outer side. Lining of tympanum.
Epithelium.

BLOODVESSELS.—The arteries of the tympanum are furnished from the following branches of the external carotid, viz., internal maxillary, posterior auricular, ascending pharyngeal; and some offsets come also from the internal carotid in the temporal bone. The veins join the middle meningeal and pharyngeal trunks. Arteries are branches of carotid.
Veins.

From internal maxillary.

a. The internal maxillary artery supplies a *tympanic branch* (inferior), which is distributed in the membrane of the tympanum. It gives also an *offset* to the cavity from the *petrosal branch* of the *middle meningeal artery*; this enters the temporal bone by the *hiatus Fallopii*.

Posterior auricular.

b. The *stylo-mastoid branch* of the posterior auricular artery, entering the lower end of the aqueduct of Fallopius, gives twigs to the back of the cavity, and the mastoid cells. One of this set, *superior tympanic*, anastomoses with the tympanic branch of the internal maxillary artery, and forms a circle around the *membrana tympani*, from which branches are directed inwards.

Inferior palatine.

c. Other branches from the ascending pharyngeal, or from the inferior palatine artery, enter the space along the *Eustachian tube*.

Nerves from several sources.

NERVES.—The lining membrane of the tympanum is supplied from the plexiform communication (*tympanic plexus*) established between Jacobson's and the sympathetic nerve: but the muscles derive their nerves from other sources. Crossing the cavity is the *chorda tympani branch* of the facial nerve.

Dissection to prepare the nerves

Dissection.—The preparation of the tympanic plexus will require a separate fresh temporal bone, which has been softened in diluted hydrochloric acid, and in which the nerves have been hardened in spirit.

before entering,

The origin of Jacobson's nerve from the *glosso-pharyngeal* is first to be sought close to the skull (p. 113); and the auricular branch of the *pneumo-gastric* is to be looked for at the same time.

and in the tympanic cavity.

Supposing the nerves to be found, the student should place the scalpel on the outer side of the *Eustachian tube*, and carry it backwards through the vaginal and styloid processes of the temporal bone, so as to take away the outer part of the tympanum, but without opening the lower end of the aqueduct of Fallopius, lest the facial nerve should be injured. After the tympanum has been laid open, Jacobson's nerve is to be followed in its canal; and the branches that lie in the grooves on the surface of the promontory are to be pursued—one of these arching forwards and two coursing upwards.

The connections of the *chorda tympani nerve* can be seen on the preparation used for the muscles.

Tympanic nerve

The *tympanic branch* of the *glosso-pharyngeal nerve* (nerve of Jacobson, p. 116) enters a special aperture in the temporal bone, and is conducted by it to the inner wall of the tympanum. In this cavity the nerve supplies filaments to

the lining membrane; and it terminates in the three following and other branches, which are contained in grooves on the promontory, viz.: and connect this nerve with others.*

Branches.—*a.* One branch is arched forwards and downwards, and enters the carotid canal to communicate with the sympathetic on the artery (p. 122). One to the sympathetic.

b. A second is directed upwards to join the large superficial petrosal nerve in the hiatus Fallopii (p. 150). Another to petrosal nerve.

c. And the third filament has the following course to reach the otic ganglion: it ascends towards the upper surface of the petrous part of the temporal bone, passing in front of the fenestra ovalis but beneath the canal for the tensor tympani muscle, and near the gangliform enlargement on the facial nerve, to which it is connected by filaments (p. 154). Beyond the union with the facial, the nerve is named *small superficial petrosal*, and is continued forwards external to the hiatus Fallopii, but without appearing on the surface of the temporal bone, until it issues from the skull to end in the otic ganglion (p. 155). And a third to otic ganglion.

This called small petrosal.

Nerves to muscles.—The tensor tympani muscle is supplied by a branch from the otic ganglion (p. 155); the stapedius receives an offset from the facial trunk; and the laxator tympani from the chorda tympani nerve (?). Nerves for the muscles.

The *chorda tympani* is a branch of the facial nerve, and is now seen in the part of its course through the tympanum. Entering the cavity behind, it crosses the membrana tympani, and issues from the space by a special aperture internal to or in the Glasserian fissure, to join the gustatory nerve. Its farther course is described at page 99. Chorda tympani crosses cavity.

The *auricular branch* of the vagus nerve, though not a nerve of the tympanum, is an offset to the outer ear, and may be now traced in the softened bone. Arising in the jugular fossa (p. 117), the nerve enters a canal, which conducts it across the lower end of the aqueduct of Fallopius, and through the substance of the temporal bone to the back of the pinna of the ear. Branch of vagus to the outer ear.

THE LABYRINTH.—The inner portion of the organ of hearing is so named from its complexity. It consists of dense osseous parts; and of membranous sacs for the expansion of the auditory nerve, which are contained within the former. It is divided into an osseous and a membranous labyrinth. Labyrinth formed of osseous and membranous parts.

* Instead of viewing these filaments as offsets of the nerve of Jacobson, it may be supposed that they are branches derived from the other nerves to which they are united. According to this view the *tympanic plexus* would be derived from many sources.

- Constituents of the osseous part. The OSSEOUS LABYRINTH consists of three parts, viz., the vestibule, the semicircular canals, and the cochlea: these communicate externally with the tympanum, and internally through the meatus internus with the cranial cavity.
- Vestibule. The VESTIBULE is the common central cavity of the osseous labyrinth, and is placed behind the cochlea but in front of the semicircular canals.
- Dissection to see it. *Dissection.*—This cavity may be seen on the dry bone that has been used for the preparation of the tympanum. The bone is to be sawn through vertically close to the inner wall of the tympanum, so as to lay bare this wall and the fenestra ovalis leading into the vestibule. In this section one of the semicircular canals (horizontal) may be laid open just above the fenestra ovalis. By enlarging the fenestra ovalis a very little in a direction upwards and forwards, the end of the superior semicircular canal and the vestibular space will appear. Other views of the cavity may be obtained by sections of temporal bones in different directions, according to the skill and knowledge of the dissector.
- Form and dimensions. The vestibular space is somewhat oval in form (fig. 129), the extremities of the oval being placed forwards and backwards, and the under part or floor is more narrowed than the upper part or roof. It measures about $\frac{1}{3}$ th of an inch in different directions, but it is narrowest from without inwards. The following objects are to be noted on the boundaries of the space.
- Apertures before and behind. In front, close to the outer wall, is a large aperture leading into the cochlea; and behind are five round openings of the three semicircular canals.
- In outer wall. The outer wall corresponds with the tympanic cavity, and in it is the aperture of the fenestra ovalis.
- Crest on inner wall; fossa in front of it; and aqueduct behind. On the inner wall, nearer the front than the back of the cavity, is a vertical ridge or *crista*. In front of the ridge is a small circular depression, *fovea hemispherica*, which presents anteriorly some minute apertures for nerves, and corresponds with the bottom of the meatus auditorius internus. Behind the crest of bone, near the common opening of two of the semicircular canals, is the small opening of the aqueduct of the vestibule: this tube ends on the posterior surface of the petrous portion of the temporal bone.
- Roof has a fossa. On the roof is a slight transversely oval depression, *fovea semi-elliptica*; this is separated from the fovea hemispherica by a continuation of the crista before mentioned on the inner wall.
- Three canals; The SEMICIRCULAR CANALS (fig. 129) are three osseous tubes,

which are situate behind the vestibule, and are named from their form.

Dissection.—These small canals will be easily brought into view by the removal of the surrounding bone by means of a file or some cutting instrument. Two may be seen opening near the aperture made in the vestibule, and may be followed thence; but the third is altogether towards the posterior aspect of the petrous portion of the temporal bone.

The canals are of unequal lengths, but each forms more than half a circle. They communicate at each end with the vestibule, and the contiguous ends of two are blended together so as to give but five openings into that cavity. Each is marked by one dilated extremity which is called the *ampulla*. When a tube is cut across it is not circular, but compressed laterally, and measures about $\frac{1}{20}$ th of an inch, though in the ampulla the size is as large again.

From a difference in the direction of the tubes, they have been named superior and posterior vertical, and horizontal. The *superior* vertical canal (¹) crosses the upper border of the petrous part of the temporal bone, and forms a projection on the surface. Its extremities are more distant than in the other tubes: its outer end is marked by the ampulla (²), whilst the inner is joined with the following. The *posterior* vertical tube (³) is directed backwards from its junction with the preceding towards the posterior surface of the temporal bone; the upper end is united with the superior vertical canal in a common tube (fig. 130, ⁷), and the lower end is free and dilated (¹⁰). The *horizontal* canal (⁴) has separate apertures, and is the shortest of the three. Deeper in position than the superior vertical, it lies in the substance of the bone nearly on a level with the fenestra ovalis; its dilated end (⁹) is at the outer side close above that aperture.

COCHLEA.—This part of the osseous labyrinth has a position anterior to the vestibule, and has received its name from its resemblance to a snail's shell.

Dissection.—To obtain a view of the cochlea in the dried bone it will be needful to cut or file away gradually on the preparation before used for displaying the vestibule, the bone above the promontory of the tympanum, which lies between that eminence and the meatus auditorius internus; or this section may be made on another piece of bone in which the semicircular canals are not laid bare. To dissect the same parts in the recent state, a softened bone should be used.

The *cochlea* is conical in form, and is placed almost horizontally in front of the vestibular space. The base of this

preparation of them.

Length.

Termination by five openings.

One end dilated.

Form and size.

They are named

superior vertical,

posterior vertical,

and horizontal.

Cochlea.

Dissection for it in dry

and recent bone.

Form and situation.

body is turned to the meatus auditorius internus, and is perforated by small apertures ; whilst the apex is directed to the upper and anterior part of the inner wall of the tympanum, opposite the canal for the tensor tympani muscle. Its length is about a quarter of an inch, and its width at the base is about the same. Resembling a snail-shell in construction, the cochlea consists of a tube wound spirally round a central part or axis ; but it differs from a shell in the fact of the tube being subdivided into two by a partition, and in the circumstance of the central part or axis being much thicker.

In the description of the cochlea, it will be necessary to notice separately the axis or centre, and the spiral tube with its partition and two passages.

The *axis* or *modiolus* (columella) consists of the bony substance included within the coils of the spiral tube. Its shape is conical, and it is formed internally of a porous material. Its size diminishes rapidly towards the last half turn of the

how it ends above.

Fig. 128 *



Around it is a spiral piece of bone.

A spiral tube closed at one end

spiral tube, where it is very thin but not porous, and may be said to end ; though it is commonly described as being continued upwards from this spot to the tip of the cochlea. The upper extremity corresponding with the last half turn, is bent,

and enlarged after the manner of a funnel with the base uppermost, and presents a free margin.† The axis is perforated by canals as far as the last half turn, which transmit vessels and nerves in the fresh state ; and the central one is larger than the others. Winding around the axis is a thin osseous plate, the *lamina spiralis*, which projects a certain distance into the spiral tube, and forms part of the septum.

The *spiral tube* forms two turns and a half around the axis, and terminates above in a closed extremity, named the *cupola*.

* The cochlea laid open to show the two turns and a half of the tube, with its scale (Arnold).—1. Axis or modiolus of the cochlea. 2. Osseous part (lamina spiralis) of the septum. 3. Scala tympani. 4. Scala vestibuli.

† Some Anatomists apply the term *infundibulum* to the appearance which this bent part of the modiolus († top of the cochlear tube) presents when it is looked at from the second turn of the cochlea. Others understand by the term the funnel-shaped space enclosed in the terminal half bend of the tube of the cochlea.

When measured along the outer side, the tube is about one inch and a half long. Its diameter at the beginning is about one tenth of an inch, but it diminishes gradually to half that size towards the opposite end. Of the turns that the tube makes, the first is much the largest; this projects at its commencement into the tympanum, and gives rise to the eminence of the promontory on the inner wall of that cavity. The second turn is included within the first. The last half turn bends sharply round, and presents a free semilunar margin (the edge of the axis) at one side. In the recent bone the tube is divided into two passages (scalæ) by a septum: in the dry bone a remnant of this partition is seen in the form of a thin plate of bone, the lamina spiralis, projecting from the axis; and on the outer wall, opposite this ridge of bone, is a slight groove.

forms $2\frac{1}{2}$ turns;
measure-
ment;

is divided
into two.

Septum of the spiral tube.—The partition dividing the tube of the cochlea into two passages in the recent bone, consists of an osseous and a membranous portion.

Septum
bony and
mem-
branous.

a. The *osseous* part, which is formed by the lamina spiralis, extends more than half way across the tube. It begins inferiorly in the vestibule, where it is wide, and is attached to the outer wall so as to shut out the fenestra rotunda from that cavity; and diminishing in size in its progress, it ends in a free point, named the *hamulus*, opposite the margin of the axis at the last half turn of the cochlea. Between the hamulus and the axis is a space which, in the recent state, is converted by membrane into a foramen (hiatus, helico-trema), and allows the intercommunication of the passages of the cochlear tube. The lamina spiralis is formed by two plates of bone, which enclose canals for vessels and nerves, and are separated furthest at the modiolus.

Osseous
part;

ends above
in a point

over an
aperture,
through
which the
scalæ join;

The side of the spiral bony plate which is turned to the lower of the two cochlear passages is pierced freely by apertures for nerves and vessels. The opposite is covered in the outer fifth of its extent by a structure resembling cartilage, which ends in wedge-shaped teeth near the margin of the bony plate, and has been named *denticulate lamina*. Between the teeth and the underlying bone is a channel, lined by club-shaped nuclear bodies like columnar epithelium (Todd and Bowman), and named *sulcus spiralis*.

difference
on two
surfaces;
on upper
aspect is
the denticu-
late struc-
ture.

b. The *membranous* part reaches from the edge of the lamina spiralis to the groove in the outer wall of the tube of the cochlea. Its width varies. Near the base of the cochlea it forms half of the partition across the tube, but at the apex

Mem-
branous
part.
Width and
extent.

where the bony part is wanting, it constructs alone the septum.

Has two strata.
One glassy looking, with transverse lines:

This membrane (basilar layer) has a glassy appearance like the elastic layers of the cornea. Close to the lamina spiralis it is homogeneous in texture, but farther out it possesses fine radiating lines, which cause it to split in shreds in the same direction. And near its outer attachment there is a gelatinous looking tissue (cochlearis muscle, Bowman; ligamentum spirale, Köl liker) fixing it to the bone.

the other a thin layer.

On the surface of the glassy or basilar layer turned towards the vestibular scala is a thin membrane (Corti). It consists of a special striated lamella, covered by the lining membrane of the scala, which is separated from the basilar layer by a space to be afterwards noticed.

Space separating the two.

Bodies of Corti and other structures uncertain.

With the aid of the microscope modifications in the texture of the glassy layer of the septum, together with other bodies on its vestibular surface with a very complicated arrangement, have been described by recent observers. But as the researches into the nature of the structures in question are far from complete, and as the interpretation to be given to the microscopic appearances is as yet uncertain, a more particular notice of them seems scarcely suited to a text-book for students.*

Two scalæ of the cochlear tube

Scala of the cochlea (fig. 128).—These are the two passages into which the tube of the cochlea is divided by its septum. They are placed the one above the other, and are named *scala vestibuli* and *scala tympani*; the former (¹) is nearest the apex of the cochlea. Above they communicate through the aperture named helicotrema. Below they end differently, as the names express: the *scala vestibuli* opens into the front of the vestibule; the *scala tympani* is shut out from the vestibular cavity by the septum cochlea, and is closed below by the membrane of the fenestra rotunda. On the whole they are nearly equal in size, but each has certain peculiarities; thus the vestibular scala is largest above and extends to the apex of the cochlea; whilst the tympanic scala (²) is largest near the base. Connected with the last is the small *aqueduct* of the cochlea, which begins close to a ridge or crest near the large end of the scala, and ceases at the under aspect of the petrous portion of the temporal bone.

that join above.

They differ in extent, and size at spots.

A third

A third small scala or passage in the cochlea has been

* If the student is desirous of further information, he may consult the recent work in English of Professor Köl liker. In this work will be found a summary of the observations referred to above, and a reference to other sources of information.

described (Kölliker) between the basilar layer and membrane of Corti in the membranous part of the septum of the spiral tube. From its position between the other two scalæ it has been called *scala media*. It is said to contain a fluid, and to have a pavement epithelium at spots, especially in the sulcus spiralis.

Lining membrane of the osseous labyrinth.—A thin fibrous membrane lines the vestibule, the semicircular canals, and the scalæ of the cochlea, and is likewise continuous with fibrous processes in the aqueducts of the vestibule and cochlea.* On the outer wall of the vestibule it assists in closing the fenestra rotunda opening into the tympanic cavity. The outer surface of the membrane is adherent to the bone; but the inner is covered by a single layer of epithelium, with polygonal nucleated cells like that on serous membranes, and secretes a thin serous fluid, *liquor Cotunnii*, or *perilymph*. This fluid in the interior fills the scalæ of the cochlea, and surrounds the membranous labyrinth.

Fig. 129.†



has an epithelium and contains a fluid.

The MEMBRANOUS LABYRINTH (fig. 130) is constituted of two sacs containing fluid, over which the auditory nerve is expanded. The sacs are two in number, viz., the utricle and the sacculus, and have the general form of the surrounding bony parts; they are confined to the vestibule and the semicircular canals, and are surrounded by the perilymph.

Dissection.—The delicate internal parts of the ear, with their vessels and nerves, cannot be dissected except on a temporal bone, which has been put in spirit, and afterwards

Two sacs float in fluid of labyrinth.

Dissection of them in a fresh bone.

* This membrane is considered by M. Breschet to be originally part of the fibro-serous lining of the skull. He supposes that the membrane has been gradually enclosed by bone, until the connection between it and the parent structure has been obliterated, except by means of the processes in the aqueducts.—*Recherches Anatomiques et Physiologiques*.

† View of the membranous labyrinth in its bony case (Breschet).—1. Cochlea. 2. Posterior vertical semicircular canal and its membranous tube, of which the ampulla is marked by 10. 3. Horizontal canal, with its contained tube: 9, marks its ampulla. 4. Superior vertical semicircular canal and tube: 8, indicating the ampulla. 5. Utricle or common sinus. 6. Sacculus.

softened in acid. The previous instructions for the dissection of the osseous labyrinth will guide the student to the situation of the membranous structures within it, but the surrounding softened material must be removed with great care.

A lens and a microscope will be needed for the complete examination of the sacs. For the display of the blood-vessels a minute injection will be necessary.

The *utricle*. The *utricle*, or the common sinus (fig. 129, ⁵) is the larger of the two sacs, and is situate at the posterior and upper part of the vestibule, opposite the fovea semi-elliptica in the roof. It is transversely oval in form, and connected with it posteriorly are three looped tubes, which are prolonged into the semicircular canals. The sac and its offsets are filled with a clear fluid, like water, which is named endolymph; and in the wall of the sac is a small calcareous deposit (otolith) opposite the entrance of the nerve into it.

The prolongations into the semicircular canals are smaller than the osseous tubes, being only one third of their diameter; and the interval between the bone and the membrane is filled by the perilymph. In form they resemble the bony cases, for they are marked at one end by a dilatation corresponding with the ampulla of the osseous tube; and, further, two are blended at one end, like the canals they occupy (fig. 130, ⁷); they communicate with the utricle by five openings, and are filled with the endolymphic fluid of that sac. At each ampullary enlargement there is a transverse projection into the interior of the cavity, and at that spot a branch of the auditory nerve enters the wall.

The *saccul*e (fig. 129, ⁶) is a smaller and a rounder cyst than the utricle, and is placed in front of it in the hollow of the fovea hemispherica. Like the larger sac it has a translucent wall, in which is an otolith opposite the entrance of the nerve; it is also filled by endolymph. It is doubtful whether the two sacs communicate.

Structure of the sacs.—The wall of the membranous labyrinth is translucent and firm; but it is more opaque where the vessels and nerves enter it. Three strata enter into the construction of the membrane, together with bloodvessels and nerves. The outer covering is loose and flocculent, and easily detached, and contains irregular pigment cells with ramifying bloodvessels. The middle stratum is clear and tough, and appears like cartilage, or, where it is thin, like the hyaloid membrane of the eyeball. It exhibits however an appearance of fibrillation; and on the addition of acetic acid nuclear looking bodies become visible. (Todd and Bow-

man.) And the inner one is formed by a layer of polygonal inner-nucleated cells, which are easily separated from one another.

The small calcareous masses, or the *otoliths*, consist of minute rounded and elongated grains of carbonate of lime, which are situate in the inner part of the wall of the utricle and saccule. Within the enlargement of each semicircular tube a calcareous material (otolith) is contained in the cells lining it. (Todd and Bowman.)

Otoliths are grains of lime.

BLOODVESSELS.—The membranes of the labyrinthic cavity receive their blood from an artery that enters the internal auditory meatus with the nerve. The veins are united into one, and end in the superior petrosal sinus.

Bloodvessels of the membrane.

The *internal auditory artery* arises from the basilar trunk within the skull (p. 194), and enters the internal meatus with the auditory nerve. In the bottom of that hollow it divides into two branches—one for the vestibule, the other for the cochlea.

Internal auditory artery

The *branch to the vestibule*, after piercing the wall of the cavity, subdivides into small branches, which ramify over the exterior of the membranous labyrinth and the tubes occupying the semicircular canals. The vessels end in a network of capillaries on the exterior as well as in the substance of the special layer, and this is most developed about the termination of the nerves.

has a branch to membranous sacs;

termination;

The *branch to the cochlea* subdivides into twigs that enter the canals in the modiolus. Small offsets from these are directed outwards through holes in the lamina spiralis, and communicate together in loops near the margin of that osseous zone, but in greatest number on the surface towards the tympanic scala. From this anastomosis vessels are supplied to the membrane lining the scalæ, and to the structure called cochlearis muscle; but the septum cochleæ prevents the communication of the vessels of the two passages.

and another to the cochlea.

Mode of termination.

A capillary vessel (? venous) is placed longitudinally on the surface of the membranous part of the septum cochleæ, which is turned to the scala tympani; and communicates here and there with the arterial loops before mentioned.

Longitudinal vessel.

The *vein*.—One branch of vein is derived from the cochlea, and another from the membranous labyrinth: the two are united near the cochlea, and the trunk ends in the superior petrosal sinus in the base of the skull.

Vein to petrosal sinus.

NERVE OF THE LABYRINTH.—Only one special nerve, *auditory* (p. 201), is distributed to the labyrinth. Entering the internal auditory meatus, the nerve divides into two branches, like the artery, viz., an anterior for the cochlea, and a posterior for the vestibule.

Auditory nerve

divides into two.

and a posterior for the membranous labyrinth. In the trunk and in both branches there are nerve cells contained : in the nerve to the labyrinth they form a reddish swelling, which was named *intumescencia ganglioformis* by Scarpa.

A cochlear branch,

whose filaments end in the septum.

The *cochlear branch* divides at the base of the modiolus into twigs that enter the apertures in the bone. These small offsets of the nerve are directed outwards with the vessels in the canals in the lamina spiralis, but nearest the tympanic scala, where they form a plexiform arrangement, with lengthened interspaces and ganglion cells. At the edge of the bone the nerve tubules reach a short distance into the membranous part of the septum scalarum, where they are arranged in conical sets parallel with one another, and end on or in the inner transparent glassy part of the septum cochleæ. The nerve fibres do not lose the white substance of Schwann at their termination, but retain it in the minutest tubules (Bowman).

Professor Köl liker states that the nerves end on the vesti-

bular surface of the membranous part of the septum, after passing through apertures in the glassy or basilar layer of the septum cochleæ, and he supposes that they are connected in some way with the bodies described by M. Corti.

The *vestibular branch* ends in three nerves for the membranous labyrinth : these

Fig. 130.*



Vestibular branch divides into three ;

pierce the cribriform plate in the bottom of the meatus, and are thus distributed :—One appertains to the utricle, and to the enlargements on the tubes contained in the superior vertical and horizontal semicircular canals (fig. 130, ²) ; a second (³) ends in the saccule ; and the third belongs to the ampullary swelling on the tube in the posterior vertical semicircular canal (¹⁰).

* Membranous labyrinth separated from the bone ; and the primary branching of the nerve (Breschet).—1. Facial nerve. 2, 3. Vestibular branches ; and 4, cochlear branch of the auditory nerve. 5. Utricle. 6. Saccule. 7. Common opening of the tubes of the two vertical semicircular canals. 8. Ampulla of the tube of the superior vertical ; 9. Ampulla of the tube of the horizontal ; and 10, ampulla of the tube of the posterior vertical semicircular canal : distributed to the last ampulla is the third branch of the auditory nerve. 11. Undilated end of the tube of the horizontal canal.

On the *membranous sacs* the nerve divides, and its filaments separate; some fibrils passing through the otolith and others outside it. Those which pass outside the calcareous matter, spread out on the inner surface; and meeting with the lining of nucleated cells, the tubules lose the white substance of Schwann, and end probably in a "fibrous film," like that of the inner stratum of the nervous layer of the retina (Todd and Bowman). The same authors state that the tubules surrounded by the otolith appear to terminate in free points, without losing their white substance.

Termination
on the sacs,

they lose
white sub-
stance,

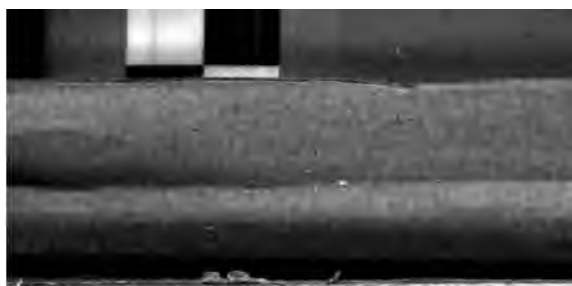
and end in
fibres inside.

In the *ampullary enlargement* of the tubes of the semi-circular canals the nerve enters the concave side, where it forms a forked eminence (Steifensand), corresponding with the projection in the interior. The nerve is confined to the swelling, and it divides at first into two chief parts, which are directed to the sides. From these primary branches are given fine fibrils, which communicate, and, piercing the membranous coat of the tube, seem to end as in the larger sacs, according to recent observations.

In the tubes
they form
projections,

and, branch-
ing, end
inside.





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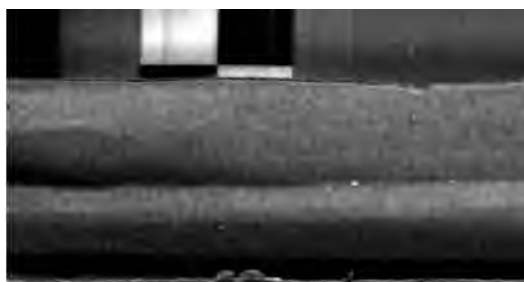
The letter (o) refers to the origin, (c) to the course, and (d) to the distribution of a nerve or vessel that is not described in the same page.

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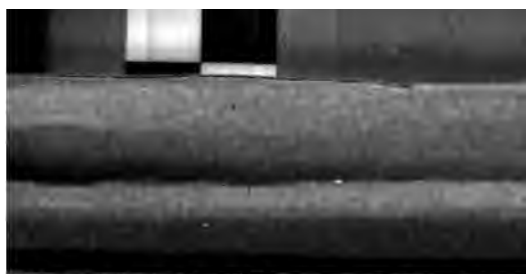
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